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"Q" FEVER IN SOUTH AUSTRALIA: I. ISOLATION OF CAUSATIVE ORGANISM FROM FOUR CASES AND ITS IDENTIFICATION AS RICKETTSIA BURNETI.

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"Q" FEVER was first described in Australia by Derrick (1937), when it was observed that between 1933 and 1935 an unidentified febrile disease was occurring among abattoir workers in Queensland. The causative organism was recovered by Burnet and Freeman (1937) and named *Rickettsia burneti* by Derrick (1939). At about the same time a rickettsia was isolated from ticks in Montana by Davis and Cox (1938). This organism, named *Rickettsia diaporica* by Cox (1939), was later shown by Burnet and Freeman (1939) to be antigenically identical with *Rickettsia burneti*.

"Q" fever was not recognized as a disease of economic importance in the United States of America until 1946, when two severe outbreaks occurred among abattoir workers, one in Amarillo, Texas (Irons *et alii*, 1947), and the other in a Chicago packing house (Shepard, 1947). Later, the disease was shown to be endemic in dairy cattle (Huebner *et alii*, 1948), sheep and goats in California (Lennette, 1949).

After several explosive outbreaks amongst Allied troops in Italy "Q" fever was found to be endemic in a number of widely separated areas (Feinstein *et alii*, 1946; Commission for Acute Respiratory Diseases, 1946). Similar outbreaks occurred among German and later among British troops in Greece (Caminopetros, 1948). "Q" fever has also been found in Switzerland (Gsell, 1948), Rumania (Combiesco *et alii*, 1949) and Turkey (Payzin, 1949), and a large outbreak occurred in several villages near Tübingen in Western Germany (Heni and Germer, 1949). *Rickettsia burneti* has been isolated from several species of ticks in North Africa (Annotation, 1948; Blanc and Bruneau, 1949), and various ruminants are known to be infected there. Recently a few cases have been described in England (MacCallum *et alii*, 1949).

Since Derrick's investigations, "Q" fever has not been described in any State in Australia other than Queensland. It is of interest therefore to record an outbreak which occurred amongst abattoir workers in South Australia in the summer of 1947-1948. The disease was first recognized clinically by Dr. J. M. Dwyer in December, 1947, when several of his patients, all abattoir workers, contracted an unidentified acute febrile illness. Five other patients were admitted to the Royal Adelaide Hospital, and these with Dr. Dwyer's patients were serologically proved to be suffering from "Q" fever by Dr. J. I. Tonge of the Queensland Laboratory of Microbiology and Pathology.

Blood samples from three of the hospital patients were submitted to laboratory investigation and *Rickettsia burneti* was isolated from two of them.

ISOLATION OF RICKETTSIA BURNETI.

Inoculation of Animals.

Blood samples, either defibrinated or as blood clot, were received from the three patients (designated as "D", "J" and "H"). These were inoculated into both guinea-pigs and mice.

Guinea-Pigs.

Male guinea-pigs weighing from 400 to 600 grammes were used. For each blood sample two were inoculated intraperitoneally with two to five millilitres of defibrinated blood or ground-up blood clot. Rectal temperatures were

taken once a day until fever developed and then twice a day, usually about mid-morning and mid-afternoon.

The incubation period varied considerably. The "J" guinea-pigs developed a temperature of 104·9° and 104·5° F. on the eighth day; the "H" guinea-pigs developed temperatures of 105·2° and 104·6° F. on the tenth day; and the "D" guinea-pigs developed temperatures of 105·2° and 104·9° F. on the fourteenth day. One of each pair was killed on the second day of fever for post-mortem examination. Temperatures in the surviving guinea-pigs of each pair fell below 104° F. after the second day, though the "J" guinea-pigs sustained a temperature of about 103·5° F. for six days. The temperatures of the others remained below 103° F. for the rest of the experimental period. At no time did the animals appear incapacitated by the infection.

Examination of the three guinea-pigs which were killed in the febrile period revealed slightly enlarged, ovoid, mottled spleens, but there were no other abnormalities. Examination of impression smears taken from the spleens and stained by Castaneda's[1] method revealed no rickettsiæ. This finding was in accordance with that of Burnet and Freeman (1939) in their studies of the Australian strain.

Further inoculation of splenic material from these animals into fresh guinea-pigs produced no febrile response, but the inoculation of ground-up spleen and liver emulsion into yolk sacs of seven-day chick embryos initiated a moderately heavy infection, organisms being seen in smears of yolk sac stained with Leishman's stain,[2] but not by Castaneda's method.

Complement fixation tests on serum from the animals were very limited. Of the survivors, only the "H" and "J" guinea-pigs were bled by cardiac puncture about five months after inoculation. The "J" guinea-pig had a complement-fixing titre of 1 in 256 to a homologous yolk-sac antigen, while the "H" guinea-pig gave a complement-fixing titre of 1 in 64 to the "J" antigen.

Mice.

Each blood sample from the patients was also inoculated intraperitoneally into six mice in one-millilitre volumes. Three out of six "D" mice were killed on the thirteenth day, slight splenic enlargement being present, but no rickettsiæ were seen in impression smears. Inoculation of spleen emulsions from these was injected intraperitoneally into six mice. Three were killed on the tenth day, one died and two were killed on the eighteenth day. Only one mouse in the first group had an enlarged spleen; the rest of the spleens were normal and no rickettsiæ were seen in impression smears of spleen stained by Castaneda's method. Some months after, the survivors were discarded without examination. On the thirteenth day after inoculation three of the six "J" mice were noticeably ill. They were sluggish in movement, with hunched backs, ruffled fur and obvious tremors. An immediate post-mortem examination disclosed moderately enlarged spleens in all three, and in two the livers were enlarged, pale, mottled and very friable. No rickettsiæ were seen when impression smears of the livers and spleens were stained by Castaneda's method. (As infection with *Rickettsia burneti* in mice is usually asymptomatic, it is difficult to explain this manifestation of illness, for even with the heaviest infection no symptoms have since been seen in mice inoculated with either of the two strains isolated.) The second group of three mice was killed a month after inoculation and the spleens were found to be enlarged, but no rickettsiæ were detected in smears.

Three of the six "H" mice died of intercurrent infection within two or three days of inoculation, and the remaining three were killed on the ninth day. On post-mortem examination two of these three mice had moderately enlarged spleens, but the livers were normal. No rickettsiæ were seen in smears stained by Castaneda's method.

Inoculation of Chick Embryos.

The spleens from each separate group of mice were ground up individually and diluted to make 10% suspensions in normal saline. Each suspension was inoculated into the yolk sacs of half a dozen six-day to seven-day embryos. These were candled twice a day until death or harvesting. Material from "D" mice did not initiate infection in eggs in any of the several attempts made to isolate the organism. However, the splenic material from "J" mice, killed on the thirteenth day, was inoculated into the yolk sac of seven-day embryos, causing infection of varying degrees of severity. Some of these embryos died at four to five days and were bacteriologically sterile, but very few rickettsiæ were seen in smears of yolk sacs stained by Castaneda's method. However, two embryos which survived until the eighth and ninth days were fairly heavily infected, but appeared normal. Only three passages in the yolk sac were necessary to establish a constantly heavy infection, the embryo dying four and a half to five days after inoculation. The yolk sacs were bacteriologically sterile.

Ground-up spleen from the three "H" mice was inoculated into the yolk sac of six-day chick embryos. Only three of these survived for any length of time, and these were harvested on the fifth day when two were dead and one was alive. Examination of smears gave no clear indication of infection. The yolk sac of one of the dead embryos was ground up, suspended in sterile saline, and inoculated into the yolk sac of a further half-dozen six-day chick embryos. These were harvested on the fifth day when all the embryos were alive and apparently normal in appearance. However, yolk sacs from four out of six of these embryos were found to be heavily infected (in smears stained by Leishman's method, but not Castaneda's), and one of these was used for the succeeding inoculation; from this heavy infection was again produced in most yolk sacs, embryos dying between seven and eight days later. Only the most severely infected yolk sacs were used in subsequent passages, and by the seventh passage very heavy infection was established, the embryos dying at between four and four and a half days.

The appearance of embryos dying from "Q" fever infection was typical. Hyperæmia and multiple hæmorrhages (Commission of Acute Respiratory Diseases, 1946) were the chief characteristics of embryos that died of infection when their yolk sacs had been inoculated on the seventh and eighth days. The course of hyperæmia was as follows: the capillaries of the down follicles and wing feathers were the first involved, followed by the deeper vessels of the leg, head and neck, and finally the whole body of the embryo became involved, when the embryo was grossly hæmorrhagic and gelatinous in texture. The severity of hyperæmia varied considerably, since death intervened at any time after the appearance of the earliest signs. The yolk sac was rarely involved, and then patches of congestion occurred in the network of capillaries towards the base. In embryos whose yolk sacs were inoculated on the fifth and sixth days, the course of hyperæmia was less clear-cut, a cherry-red appearance being present at death.

Burnet and Freeman (1941) were not able to induce infection of the chorio-allantoic membrane with the Australian strain of *Rickettsia burneti*. However, in the course of the work it was noticed on one or two occasions, when yolk-sac inoculated embryos were being harvested, that the chorio-allantoic membrane at the point of inoculation was œdematous, and examination of smears from the

[1] Rivers's (1931) modification of Castaneda's method was used for staining smears of liver, spleen and yolk sac in all the earlier work; the only change made in our method was that the smears were stained for ten minutes instead or two as recommended by Rivers. Later it was found that the period of staining with Löffler's methylene blue was not sufficient, and that a period from twenty to thirty minutes produced much more definite results. Consequently in much of the earlier material examined light to medium infections were most probably missed and much of the material examined was not redeemable. However, yolk sac material in some cases was still available, and where the original smears stained by Castaneda's method, as above, gave negative findings smears stained with Leishman's stain showed heavy infection.

[2] The use of Leishman's reagent for staining rickettsiæ in yolk-sac smears has been adopted in Dr. F. M. Burnet's laboratory. It has been found invaluable in this laboratory, since it is far more reliable than either Castaneda's stains or Macchiavello's method. However, it is not suitable for animal tissues.

area stained by Castaneda's method revealed heavy infection of the membrane. Sub-inoculation of yolk-sac material to the chorio-allantoic membrane of nine-day to eleven-day chick embryos produced infections which varied considerably both in intensity of infection and in the degree of œdema produced; nor were these two factors entirely related, since pronounced œdema was not always indicative of heavy infection.

Isolation from Laboratory Infections.

In the course of these investigations, three laboratory infections occurred from four to six months after the work started, but all prior to the introduction of the Henzerling strain. (See below.) None of the infections was severe, fever lasting from four to five days. Blood samples were taken on either the first or the second day, and inoculation was carried out as previously described. In Case I, six mice only were used, and in the other two both mice and guinea-pigs were used. In each of these cases infection was demonstrated by a rise in complement-fixing titre in the serum from 0 to 1 in 64 and more in one month from the date of infection.

Mice.

Three of the six mice infected from Case I were killed on the eighth day; examination revealed only slightly enlarged spleens, and no rickettsiæ were seen in the smears. The surviving three mice were killed on the eleventh day, when their spleens were found to be enlarged, one having a slightly enlarged, pale liver. A few colonies of rickettsiæ were seen intracellularly in impression smears of the spleens and livers. A suspension of spleens inoculated into the yolk sac of chick embryos initiated a moderately heavy infection.

Nine mice were inoculated with blood from the patient in Case II. Three were killed on the eighth day; the spleens and livers were normal, and examination of smears gave negative results. Three were killed on the tenth day; the spleens of two were enlarged, and the livers were pale but not noticeably enlarged. A few intracellular colonies of rickettsiæ were seen in impression smears of spleens and livers. In the three mice killed on the twelfth day, both spleen and liver were enlarged, and both organs (but particularly the spleen) were covered with a fibrinous exudate. Examination of smears of spleens revealed a few rickettsiæ. On subinoculation, splenic emulsions initiated a moderately heavy infection in the yolk sacs of chick embryos.

The mice infected from Case III showed no abnormalities of spleen or liver, and in addition examination of impression smears gave negative results.

Guinea-Pigs.

One of the guinea-pigs infected from Case II had a temperature rise to 104·2° F. on the sixth day; the second remained afebrile. Serum from blood taken on the fifteenth day after inoculation gave a negative reaction in the complement fixation test.

In the guinea-pigs inoculated with blood from the patient in Case III, no febrile response was seen. From one killed on the fourteenth day a normal liver and spleen were recovered. The other guinea-pig died from non-specific causes.

Attempts to isolate *Rickettsia burneti* from the fæces of the patients were not successful. Food was contaminated with a 10% suspension in saline of fæcal material, and fed to both mice and guinea-pigs. After a continued absence of febrile response the guinea-pigs were finally discarded. The mice were normal, and *post mortem* splenic emulsions did not initiate infection in the yolk sacs of chick embryos. The fæcal suspension from one patient was treated with penicillin (100 units per millilitre) and sulphadiazine (5% solution) in the hope that most of the natural bacterial flora would be killed, and injected intraperitoneally into guinea-pigs and mice. One of the guinea-pigs and five of the six mice died. However, the surviving mouse had a grossly enlarged spleen after ten days, although no rickettsiæ were seen in smears, and no infection was produced in other mice and chick embryos. The guinea-pig gave no febrile response, nor did it develop any complement-fixing antibody.

Preparation of Antigen.

The method adopted for preparation of antigen was a modification of those of Craigie (1946), and Topping and Shepard (1946), which proved most suitable for use in this laboratory. From 60 to 100 infected yolk sacs (previously tested for rickettsial content by smears stained with Leishman's stain, and for bacteriological sterility), were pooled and weighed in a litre beaker. To them was added one-quarter of their weight of M/15 Sorensen's phosphate buffer at pH 5·5 to 6·0, formalin being added to give a concentration of 0·5% to 0·6%. This mixture was allowed to stand for five to seven days at 4° C. to inactivate the rickettsiæ. The mixture was then transferred to an "Auto-Mix" blender and "blended" at top speed for ten to fifteen minutes, by which time the yolk sacs were well homogenized. After dilution with sufficient saline to make a final concentration of 20% of yolk-sac material, the suspension was transferred to separating funnels, extracted with one and a half volumes of anæsthetic ether, and allowed to separate overnight at 4° C. The aqueous layer was run off and pooled, and the excess ether removed *in vacuo*. It was not possible to carry out all the manipulations in the cold, so that chilled reagents were always used, and the vacuum flask was packed with ice during the last operation. The upper ether layer saturated with protein and fat was discarded.

The suspension was then centrifuged in an angle centrifuge in plastic 15-millilitre tubes, at 4000 revolutions per minute for one hour. When centrifugation was complete, the rickettsiæ were resuspended in one-tenth the original volume of calcium magnesium saline solution[1] with "Merthiolate" added to a concentration of 1 in 10,000. Examination of smears stained by Castaneda's method revealed that the suspensions still contained a considerable amount of foreign matter, which was removed by one or two further extractions with a one-third volume of ether. The excess ether was removed *in vacuo*.

An antigen was also prepared from about 60 normal yolk sacs from twelve-day and thirteen-day chick embryos for comparative studies, since it was found necessary to immunize the guinea-pigs with yolk-sac material for reasons to be explained in the next section.

Preparation of Immune Serum.

Immune serum was prepared in guinea-pigs against the two local strains and the Henzerling (Italian) strain. A 10% yolk-sac suspension of the last-mentioned strain prepared from eggs of the eighteenth passage was received from the Commonwealth Serum Laboratories.

As was previously mentioned, yolk-sac suspensions were used to immunize guinea-pigs. This method of immunization is not to be recommended, since there is every chance that the experimental animals will develop antibody to the yolk-sac material itself, and this did in fact occur in two of the five surviving "Henzerling" guinea-pigs. However, in a laboratory not equipped for the handling of such highly infectious material, it was essential to cut down the actual handling of infectious material to a minimum, and preliminary animal inoculation to prepare a suitable inoculum from spleens was considered undesirable. Guinea-pigs weighing from 400 to 600 grammes were used, six for the Henzerling suspension and four each for the "J" and "H" suspensions, each guinea-pig receiving one millilitre of the suspension by intraperitoneal injection. Washed suspensions were used to immunize the "J" and "H" guinea-pigs. These suspensions were prepared by centrifuging 10% suspension of infected yolk sac (ninth or tenth passage in embryos) for half an hour at 4000 revolutions per minute to sediment the rickettsiæ.

[1] The formula for calcium magnesium saline solution is as follows: 85 grammes of sodium chloride, 0·275 gramme of anhydrous calcium chloride, 1·92 grammes of crystalline magnesium chloride, 12·03 grammes of crystalline boric acid, and 0·52 gramme of crystalline borax. These ingredients are dissolved in 8000 millilitres of distilled water and the mixture is made up to 10,000 millilitres and autoclaved.

The supernatant was discarded and the organisms were resuspended in a corresponding volume of saline. This was done to eliminate as much yolk protein as possible.

Rectal temperatures were taken once a day until fever subsided. The time chosen for recording the temperature was usually midday, since from previous experience the maximum seemed to be reached by this time. The temperature response of some guinea-pigs was surprisingly mild and slow, particularly in those inoculated with local strains. Previous experience had led one to expect that an early and fairly severe febrile response would occur in guinea-pigs after inoculation of yolk-sac suspensions. This response occurred in all but one of the "Henzerling" guinea-pigs, which had a maximum response of 103·7° F. on the sixth and seventh days. The other five guinea-pigs developed temperatures of over 104° F. between the second and fourth days after inoculation. These temperatures were sustained for three to seven days. One of these guinea-pigs died almost four weeks after inoculation. No post-mortem examination was performed.

Of the "J" guinea-pigs, only two had temperatures of 104° F. or over on the eighth day. The temperatures of the other two guinea-pigs did not rise above 103·5° F. Two of the "H" guinea-pigs had temperatures of 104° F. on the second day, one of the guinea-pigs having a recurrence on the sixth day. In the other two, the temperatures did not rise above 103·7° F. Serum was first collected by cardiac puncture on the fifteenth day. In serum from the "Henzerling" guinea-pigs, slight responses were apparent. One of the "J" guinea-pigs had a titre of 1 in 64, but the rest gave negative findings.

On two previous occasions when immune serum was prepared in guinea-pigs against yolk-sac suspensions of the two local strains, complement-fixing titres of from 1 in 128 to 1 in 256 were produced in seventeen days. At the end of three weeks the "J" and "H" guinea-pigs were still showing weak response with titres of 1 in 8 to 1 in 32, and a second injection was given. This time the inoculum was a 10% suspension of infected yolk sac, which had not been washed. Temperatures were not recorded over the second period. The "Henzerling" guinea-pigs were re-inoculated after four weeks, since they too developed complement-fixing titres of only 1 in 32 to 1 in 64. All the guinea-pigs were bled to death by cardiac puncture, the "Henzerling" guinea-pigs twelve days after their second injection and the "H" and "J" guinea-pigs nineteen days after their second injection. Titres of all these specimens of serum were disappointingly low in comparison with earlier serum prepared here, and of each series the two specimens with the highest titres were chosen for comparative studies.

As controls, four guinea-pigs kept in the same room as the other guinea-pigs were immunized with three one-millilitre injections of a normal yolk-sac suspension, prepared from thirteen-day chick embryos, at weekly intervals. These guinea-pigs were brought into the room twenty-three days after the others, and though not held in the same cages were in association with them for nineteen days. When bled four weeks after inoculation, these guinea-pigs had developed complement-fixing titres of 1 in 32 and over to "Q" fever, and none to normal yolk sac. The high infectivity of "Q" fever even in the animal house was demonstrated by these cross-infections. A further six guinea-pigs were inoculated as controls. They received one millilitre each of a 10% normal thirteen-day yolk-sac suspension. Three weeks later three of the six guinea-pigs received a second injection similar to the first. All the guinea-pigs were bled to death by cardiac puncture nineteen days after the second injection. Temperatures were not recorded.

THE COMPLEMENT FIXATION TEST.

The method of performing the complement fixation test was a modification of that described by Bengston (1944).

Reagents Used in the Test.

All dilutions were carried out in calcium magnesium saline solution as described above. The formula for this reagent, based on the work of Mayer *et alii* (1946), was received from the Walter and Eliza Hall Institute of Medical Research.

Complement.

The complement source was guinea-pig serum, either fresh or stored in the refrigerator at −18° C. Dispensing of the complement in two-millilitre volumes into small tubes after titration was found useful, since under such conditions constant freezing and thawing were obviated and the original titre was maintained for some weeks. The complement was titrated before each test in the presence of both antigens (either four or eight units, depending on the lowest dilution to be used in the test), and a double dilution of normal yolk-sac antigen, as well as saline. Neither the antigen nor the normal yolk-sac antigen affected the complement titre. Two minimal hæmolytic doses of complement were used throughout the test.

The Sera.

In the preliminary titrations all the sera obtained from the immunized guinea-pigs were used, also the control sera prepared by inoculation of normal yolk-sac suspensions. A control "positive" serum, prepared in guinea-pigs previous to the present group of sera, was also included in the test. These sera were inactivated at 56° C. for half an hour prior to use.

For the checker-board titrations, pooled serum was used. In each case the two sera with the highest titres were selected and pooled in equal volumes. The control negative sera were from guinea-pigs immunized with two doses of normal yolk-sac suspension given with a three-weekly interval between them.

Antigens.

The strength of antigens used throughout the test was determined by titration against pooled guinea-pig sera of known titres. Serial double dilutions of both serum and antigen were titrated against one another by the method to be described in the section on checker-board titrations. One unit of antigen was taken to be the highest dilution of the antigen to give complete or "+++" fixation after two hours' incubation at 37° C. The standard for this unit was based on the work of Lennette *et alii* (1949), but the time and temperature of fixation have been altered to suit the condition of the test to be described later. In the preliminary titrations to determine the titres of the guinea-pig sera, four units of antigen (produced by a 1 in 8 dilution of the original) were used. In all tests a double dilution of normal yolk-sac antigen was used as a control.

The Hæmolytic System.

The hæmolytic system consisted of a 2% suspension of washed sheep red cells, to which had been added two minimal hæmolytic doses of hæmolysin.

Technique of the Test.

Preliminary Titrations.

Twofold dilutions of sera were made from 1 in 4 to 1 in 1024 and were dispensed in 0·15-millilitre volumes in Wassermann tubes. Four tubes were used for each dilution up to the fourth, and three tubes for each dilution thereafter. One volume of complement (two minimal hæmolytic doses) was added to each tube. Antigen (four units) was added to the first two rows of tubes—one volume of "H" antigen to each tube in the first, one volume of "J" antigen to each tube in the second. Normal yolk-sac antigen (1 in 2 dilution) was added to each tube in the third row. The fourth row consisting of the first four dilutions only, and acting as serum control, had one volume of saline added to each tube. The three tubes which were to contain the antigen controls had one volume of complement added and two volumes of the respective antigens.

The tubes were incubated for two hours at 37° C., after which two volumes of the hæmolytic system were added. After further incubation for an hour at 37° C. the tubes were placed overnight at 4° C. and the results were read on the following morning. The end point was taken as 75% fixation.

TABLE I.

Source of Serum and Serum Dilutions.	Antigen Dilutions.																		Saline Control.
	"H" Antigen.[1]						"J" Antigen.[1]						Normal Yolk Sac.						
	1/4	1/8	1/16	1/32	1/64	1/128	1/4	1/8	1/16	1/32	1/64	1/128	1/2	1/4	1/8	1/16	1/32	1/64	
Henzerling P88, P90—																			
1/4	4	4	4	4	4−	2	4	4	4	4	2	2	4	4	4	4	3	1	0
1/8	4	4	4	4	4−	3+	4	4	4	4	3	2+	4	4	4	4	3+	2	0
1/16	4	4	4	4	4−	3	4	4	4	4−	2	2	4	4	3+	3	2	1	0
1/32	4	4	4	4	4	3	4	4	4	3+	1+	1	2+	3	3	2	1	tr.	0
1/64	4	4	4	4	3+	1	4	4	4	3	1	1	1	1	tr.	tr.	tr.	tr.	
1/128	1	1+	1+	1+	2	tr.	1+	3	2	2	1	tr.	tr.	tr.	tr.	tr.	0	0	
1/256	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	tr.	0	0	0	0	0	0	
1/512	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

[1] Antigen controls, negative findings; "4" = complete fixation; "0" = complete lysis. "+" and "−" signs indicate degrees of fixation between those expressed by the numerals. "Tr." = trace.

The Checker-Board Titrations.

The method of performing checker-board titrations was based on the work of Topping, Shepard and Huebner (1946), and was similar to that of the previous tests, except that twofold serum dilutions ranging from 1 in 4 to 1 in 1024 were titrated against twofold antigen dilutions of 1 in 4 to 1 in 128, the resultant checker-board pattern being shown in Table I. The first four dilutions of each serum were also set up with saline and normal yolk-sac antigen diluted 1 in 2 as controls. Besides the immune guinea-pig sera, pooled serum from the three guinea-pigs inoculated with a normal yolk-sac suspension (two injections with a three-weekly interval) was included as the control serum. Antigen controls were also included in the test.

The results of preliminary titrations were as follows.

1. The "Henzerling" guinea-pig sera yielded titres of between 1 in 32 and 1 in 256. However, two of these sera developed strong complement-fixing titres to normal yolk-sac antigen (Table I), and could not be used. The other three were free from normal yolk-sac antibody, and the two higher-titred sera were selected and pooled in equal volumes for all tests.

2. The "H" guinea-pig sera were free from normal yolk-sac antibody. The titres ranged from 1 in 32 to 1 in 128, and as before the two highest-titred sera were selected.

3. The "J" guinea-pig sera, like the "H" sera, were free from normal yolk-sac antibody. Titres ranged from 1 in 32 to 1 in 512. Two sera with titres of 1 in 128 and 1 in 512 were pooled in equal portions and used for the tests. No great difference in the reaction of the antigen to the different sera was observed, nor did the second inoculation seem to make much difference to the complement-fixing titres.

TABLE II.

Source of Guinea-pig Serum and Serum Dilutions.	Antigen Dilutions.												Saline.	Normal Yolk-Sac Antigen Diluted 1 : 2.
	"H" Antigen.[1]						"J" Antigen.[1]							
	1/4	1/8	1/16	1/32	1/64	1/128	1/4	1/8	1/16	1/32	1/64	1/128		
Henzerling P86 and P87—														
1/4	4	4	4	4−	2+	tr.	4	4	4	4	2	tr.	0	0
1/8	4	4	4	4−	3	tr.	4	4	4	3+	2	tr.	0	0
1/16	4	4	4	4	3	tr.	4	4	4	4−	2	tr.	0	0
1/32	4	4	4	4−	3	0	4	4	4	4−	1+	1	0	0
1/64	4	4	4	3+	1	tr.	4	4	4−	4−	1	tr.		
1/128	1	1	tr.	1	tr.	0	2	2	1	1	tr.	tr.		
1/256	0	0	0	0	0	0	tr.	tr.	tr.	0	0	0		
1/512	0	0	0	0	0	0	0	0	0	0	0	0		
"H" P92 and P93—														
1/4	4	4	4	3	2	tr.	4	4	4	3	1	tr.	0	0
1/8	4	4	4	4	2	tr.	4	4	4	3	2	tr.	0	0
1/16	4	4	4	4	4	1	4	4	4	4−	2	tr.	0	0
1/32	4	4	3+	4	4	2	4	4	4	4	2	tr.	0	0
1/64	3	4	3	3	4	1	4	4	4−	4	3	tr.		
1/128	1	1	1	1	2	tr.	1	1	1	3	1	0		
1/256	0	0	0	0	0	0	0	0	0	0	0	0		
"J" P95 and P96—														
1/4	4	4	4	4	2	tr.	4	4	4	3	1	1	0	0
1/8	4	4	4	4	3	tr.	4	4	4	3	1	tr.	0	0
1/16	4	4	4	4	2	2	4	4	4	4	1	1	0	0
1/32	4	4	4	4	2	2	4	4	4	4	4	1	0	0
1/64	4	4	4	4	4	2	4	4	4	4	4	2		
1/128	4	4	4	4	4	3	4	4	4	4	4	2		
1/256	1	4	3	4	4	3	4	4−	4	4	4	3−		
1/512	0	1	0	2	3	1	1	2	3	4−	2	tr.		
1/1024	0	0	0	0	tr.	0	tr.	0	0	0	tr.	tr.		
Control P105, P106 and P107—														
1/4	0	0	0	0			0	0	0	0			0	0
1/8	0	0	0	0			0	0	0	0			0	0
1/16	0	0	0	0			0	0	0	0			0	0
1/32	0	0	0	0			0	0	0	0			0	0
1/64	0	0	0	0			0	0	0	0				
1/128	0	0	0	0			0	0	0	0				

[1] Antigen controls, negative findings; "4" = complete fixation; "0" = complete lysis. "+" and "−" signs indicate degrees of fixation between those expressed by the numerals. "Tr." = trace.

4. Guinea-pig sera from animals inoculated with normal yolk-sac suspension gave negative results.

Results.

The results of the checker-board titrations are set out in Table II, and they demonstrate the close antigenic relationship between the two locally isolated strains and the Henzerling strain, when antigens prepared from the local strains are titrated against their immune sera and Henzerling-immune serum. Using several strains of *Rickettsia burneti* and their homologous immune sera, Topping, Shepard and Huebner (1946) showed that each strain gave a checker-board titration pattern. The pattern of the checker-board titrations of the local strains tends to agree more closely with the pattern of the Henzerling strain as demonstrated by Topping, Shepard and Huebner, since the local antigens do not fix complement in such high dilution as their Australian strain, which was titrated against American immune serum.

These tests prove conclusively the identity of the organism isolated here as *Rickettsia burneti*. The earlier method of identification was less direct, since until the Henzerling strain was introduced the antigens had been tested only against human sera from cases occurring here. These sera had previously been shown to give positive results in Dr. J. I. Tonge's laboratory, where an agglutinating mouse-spleen antigen, prepared from a recognized Australian strain, was in use. The same sera were also tested by a sample of Henzerling antigen kindly provided on request by Dr. Charles Armstrong, of the United States Health Department. This antigen had deteriorated in transit, as in checker-board titrations against immune guinea-pig serum (immunized with the "J" strain of "Q" fever) it produced complete fixation at a final dilution of 1 in 8 instead of 1 in 32, as given in the specification provided with it. No comparative studies could be performed with the three antigens at the same time, since the Henzerling antigen had been exhausted previously.

Summary.

1. The occurrence of "Q" fever among abattoir workers in South Australia in the summer of 1947-1948 is recorded.

2. The isolation of *Rickettsia burneti* from two hospital patients, and in two cases of laboratory infection, is described.

3. The preparation of antigens from infected yolk sacs and of immune serum in guinea-pigs is described.

4. The close immunological relationship between locally isolated strains and the Henzerling strain is demonstrated.

Acknowledgements.

Special thanks are due to Dr. J. I. Tonge, of the Queensland Institute of Microbiology and Pathology, for the testing of sera; to Dr. Charles Armstrong, Chief of the Division of Infectious Diseases of the United States Public Health Service, for providing a sample of Henzerling antigen; and to Dr. J. L. O'Connor, of the Commonwealth Serum Laboratories, for supplying the Henzerling strain of "Q" fever.

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THE INDICATIONS FOR AND RESULTS OF ACROMIONECTOMY.

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DESPITE the long-continued and meticulous observations of Codman, the problem of supraspinatus degenerations of the shoulder still presents certain aspects which remain essentially unsolved. His classical studies gave us a much fuller understanding of the pathology of the lesions which, as usual, suggested means of treatment that have proved effective in the vast majority of cases. At least 90% of the lesions respond fully and permanently to conservative measures. Of these measures, rest, secured by the use of an abduction frame, is much the most important. It is usually supplemented by short-wave therapy or infra-red irradiation and in some cases by "Novocain" injection. This routine, pursued generally for periods of one to three months, brings gratifying results in most instances.

There remains, however, a small group of cases in which (*a*) conservative treatment may be contraindicated from the nature of the lesion or (*b*) the expected improvement does not eventuate with conservative treatment. The chief contraindication to conservative treatment is the presence of the rare complete rupture, which must be repaired if the function of the shoulder is to be regained. Failure of conservative treatment may become obvious early, or it may be only after a long period of repeated trials that more radical measures are considered.

The types under section (*b*) may be subdivided as follows. (i) In the very acute case, even the slight movements caused by ambulation bring on severe pain. Recumbency is equally painful and sleep impossible. The patient demands relief. (*ii*) *In other cases, less severe,* the patient may be unable to tolerate the abduction frame. The arm is held to the side with the adductors in spasm, so that not only humero-scapular movements but also the normal scapular rotation on the chest wall are prevented. The risk is "frozen shoulder", extremely difficult to treat by any method. (iii) The abduction frame may be tolerated and give partial relief, but the nagging day pain and accentuated night pain continue despite all therapeutic efforts. The patient cannot sleep and is unable to work, and his general deterioration makes active interference essential. (iv) In some cases apparent cure may occur, but there may be a relapse after periods of months to several years. These relapses are often of greater severity than the original attack, and in our experience have proved much more refractory.

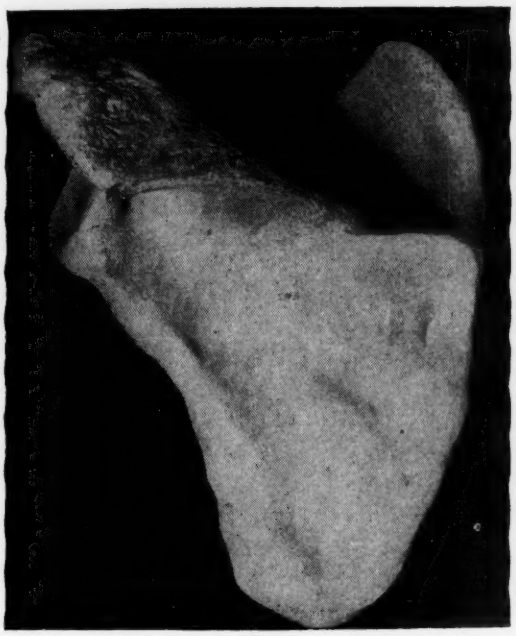

FIGURE I.

Illustrating the smooth ridged area over which the deltoid arches to reach its more medially placed origin.

Over the last five years we have found some 20 cases fitting into these categories. All patients were treated by acromionectomy and all have been followed for a sufficient period for the end result to be assessed. Several patients complaining of shoulder pain for other reasons were also considered suitable for the operation, and the results have borne out this opinion. In particular these were: two patients with old fractures of the acromion, one ununited and the other malunited, one patient with a fracture of the greater tuberosity united in an elevated position, and one patient with an old fracture of the surgical neck of the humerus which had united with an abduction deformity. The effect in each of these was due to the removal of a block of bone which presented an obstruction to the full range of shoulder movement.

Anatomy.

The acromion forms by condensation of two centres, in the middle of which the spine of the scapula ends. The bony mass formed by this condensation may fail to fuse with the spine, the line of separation running from just behind the clavicular facet to the acromial angle. This line incidentally corresponds rather closely to the line of osteotomy considered most desirable in the operation.

FIGURE II.

Note the roughened area on the under-surface of the acromion which is related to the subacromial bursa.

The acromion is broad and flat. It overlies the shoulder joint, the tendons of the supraspinatus, infraspinatus and *teres minor,* and a varying portion of the subacromial bursa. When the subject is in the relaxed upright position with the medial border of the scapula parallel to the vertebral column, it extends beyond the glenoid for about three-quarters of an inch. If the arm is abducted or the shoulder raised with the arm abducted, the scapula rotates and the acromion overlies a very small portion only of the head of the humerus.

The upper surface has a smooth ridged area in the middle portion extending over the lateral border. Over this the deltoid plays as it arches outward from a more medially placed roughened area of origin. The anterior jutting portion is roughened for the deltoid origin and the acromio-clavicular capsule. The origin of the deltoid thus passes from the posterior border of the spine to the acromial angle and then crosses over the top of the acromion to the anterior roughened area, reaches back to the anterior end of the acromio-clavicular facet, and then passes to the clavicle. It is this portion of the origin of the deltoid which is sectioned in the operation. There is very little, if any, interference with the trapezius insertion.

The under-surface of the acromion is roughened laterally in the portion related to the subacromial bursa, but becomes smooth immediately the area is reached against which the supraspinatus plays.

The Operation.

There are few references to acromionectomy in the literature. Smith-Petersen, Aufranc and Larsen in 1943 mentioned acromioplasty as one method of improving shoulder joint mobility in rheumatoid arthritis. Smith-Petersen insisted that the acromion be excised lateral to the acromio-clavicular joint—that is, that there should be no interference with the joint. McLaughlin in 1944 advocated acromioplasty or partial excision of the acromion as a method of approach, particularly to the cuff insertion, but also to the shoulder joint itself, for such operations as the Nicola procedure, labrum fixation and open reduction of fracture dislocation. He did not mention the therapeutic effect of the operation itself, and again insisted that the acromio-clavicular joint must be left

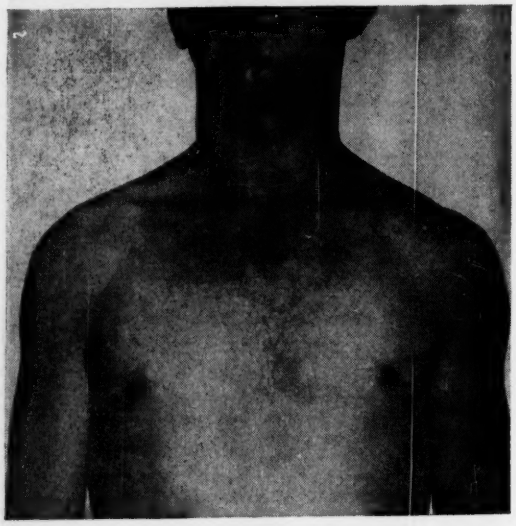

FIGURE III.

Showing the minimal alteration in contour of the shoulder. The patient illustrated had undergone right acromionectomy nine weeks previously. The sabre-cut incision is almost invisible, while the delto-pectoral incision from an old approach to the subacromial bursa has spread.

intact. He recommended minimizing the amount of acromion resected provided the exposure was adequate. His site of osteotomy is in the antero-posterior plane mid-way between the lateral border and the acromio-clavicular joint. Watson-Jones in the third edition (1946) of his book on fractures recommends acromionectomy as the treatment of choice in cuff lesions and subacromial bursitis when conservative measures have failed. He again recommends leaving the acromio-clavicular joint, though he states that he has on occasions made the division through the joint without ill effect.

The latest contribution is one by Armstrong (1949), in which 95 cases of total acromionectomy for supraspinatus syndrome are reported. His indications are similar to those mentioned above, and he reports 84% of satisfactory results. The unsatisfactory results were classified as (*a*) those in which there was some residual limitation of movement, and (*b*) those (about 4%) in which the symptoms were unrelieved.

In this series the whole of the acromion has been removed by separation at the acromio-clavicular joint and division of bone in the antero-posterior plane at the junction of spine and acromion. Intratracheal anæsthesia is used; the patient is postured on his back with a sandbag under the affected shoulder, and the head is rolled to the opposite side. The operator sits at the top of the table.

The incision passes from just in front of the acromio-clavicular joint about three inches directly back over the shoulder. The skin knife is discarded, and with a new scalpel the incision is deepened to bone, the musculotendinous origin of the deltoid being divided. The latter is then carefully dissected free from the upper and outer surfaces of the acromion with scalpel or osteotome. The acromio-clavicular joint is disarticulated and the junction of acromion and spine divided with the osteotome. The acromion is then grasped in bone-holding forceps and its remaining attachments are snipped. This gives excellent exposure to the underlying bursa and cuff insertion. The bursa is usually almost unrecognizable, owing to the presence of adhesions, and the pathological condition of the cuff is obvious. Except in cases of calcification or rupture, there is no interference with the cuff. By manipulation of the arm the whole of the greater and lesser tuberosity area of the humerus is easily brought into view. Should exploration of the joint be necessary, an incision through the cuff and capsule in the direction of their fibres gives excellent access to all the intracapsular structures. The closure is effected by suturing the divided deltoid back to its origin and the trapezius insertion. Several figure-of-eight sutures of fine stainless steel wire or silk are used. The patient is returned to the ward with the arm abducted. This position is maintained by a sling passed around the arm and tied to the top of the bed till an abduction frame can be applied, usually on about the second post-operative day, when the patient is allowed up. After-treatment consists in the use of the abduction frame for a period of about three weeks, after which gradual active mobilization is commenced.

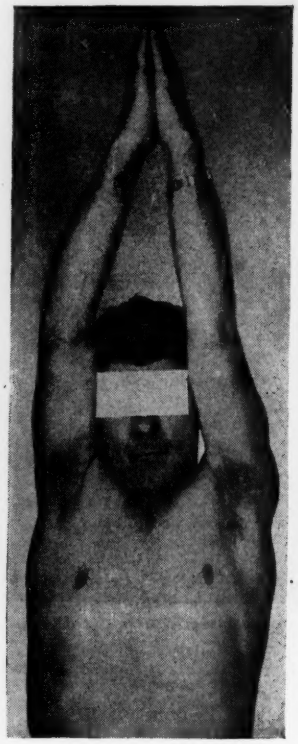

FIGURE IV.

Illustrating the range of movement regained nine weeks after acromionectomy. (This patient was not included in the series.)

We have as yet found no morbidity at all associated with these operations. The wound heals beautifully with a hair-line scar, in contrast to the tendency to spreading and keloid formation following the anterior approach to the joint. The alteration in contour of the shoulder is almost undetectable. No weakness or instability has resulted. Patients have returned to all forms of work, from practising medicine, nursing, farming *et cetera*, to labouring, without prejudice to their earning capacity.

Reports of Cases.

The following case reports are illustrative.

CASE I.—A male patient, a shopkeeper, aged forty-three years, had injured his right shoulder four years earlier; his shoulder seemed to drop. The arm was treated in a sling for five weeks, after which the shoulder felt normal except for an occasional twinge over the shoulder blade. Ten weeks previously, while playing tennis, the patient had

noticed some stiffness developing, which did not stop him playing at the time. Subsequent to this the shoulder became progressively more painful and stiff till it could not be actively abducted. On examination of the patient, there was considerable tenderness over the greater tuberosity, and acute pain on abduction, which was felt maximally at about 70°. The diagnosis of supraspinatus tendonitis with subacromial bursitis was made. The patient was treated conservatively for one month, during which time the symptoms were unrelieved and possibly somewhat accentuated. X-ray examination revealed no abnormality. He was treated by acromionectomy on August 20, 1948. Two months later the patient had a full range of movement, but complained of pain at extreme abduction. This pain persisted for a

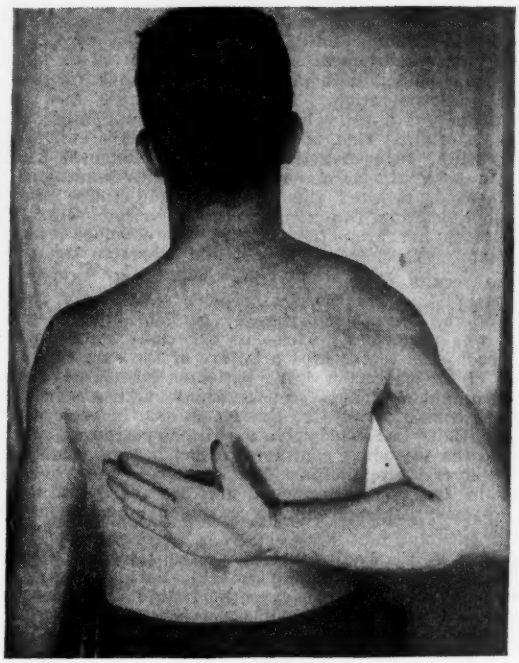

FIGURE V.

Illustrating the range of movement regained nine weeks after acromionectomy. (This patient was not included in the series.)

further two months, and it was considered advisable to remove the wire sutures. When he was last examined in August, 1949, he had a full range of movement, the strength of the joint was normal, he was able to swim and play tennis unhampered, and he had no pain and no tenderness.

CASE II.—A housewife was referred in May, 1948, because she had had severe and continuous pain and stiffness in the right shoulder for about five months. On examination of the patient, there was a tender area over the head of the humerus, and a very painful jolt occurred at about 80° of abduction. X-ray examination revealed a large calcified mass above the greater tuberosity. Acromionectomy was performed on June 28, 1948. A large tense cyst filled with calcifying grumous material was incised. After operation the pain disappeared completely. There was some delay in the return of active shoulder movements. This was accompanied by deltoid wasting. However, by September movement range had returned to three-quarter normal ,and when the patient was last examined in January, 1948, full abduction and rotation had been regained and the shoulder function was normal.

CASE VI.—A male patient, a clerk, aged forty-six years, was first examined in February, 1948, when he complained of stiffness and pain in the right shoulder. Abduction was limited to 90°, and there was tenderness over the greater tuberosity. The X-ray film revealed no abnormality. The diagnosis of supraspinatus tendonitis was made, and conservative treatment was commenced. No improvement resulted, and the shoulder was manipulated under anæsthesia in April, 1948, without relief of pain and with no improvement in movements. By August, 1948, the right shoulder was practically "frozen"; rotation movement was nil, and abduction (to 70° only) was possible almost entirely by scapular rotation. There was a continuous dull aching pain in the shoulder, which was worse at night. The greater tuberosity was tender. In addition similar symptoms were present in the left shoulder. There was a block at 90° of abduction, which could be overcome by wriggling the shoulder. The X-ray picture was normal.

On September 16 bilateral acromionectomy was performed. Within five weeks the movements of the left shoulder were full, painless and strong; the right was still practically "frozen", but painless. By November the right shoulder had regained abduction to 100° and some rotation. By March, 1949, there was half the range of rotation, and active

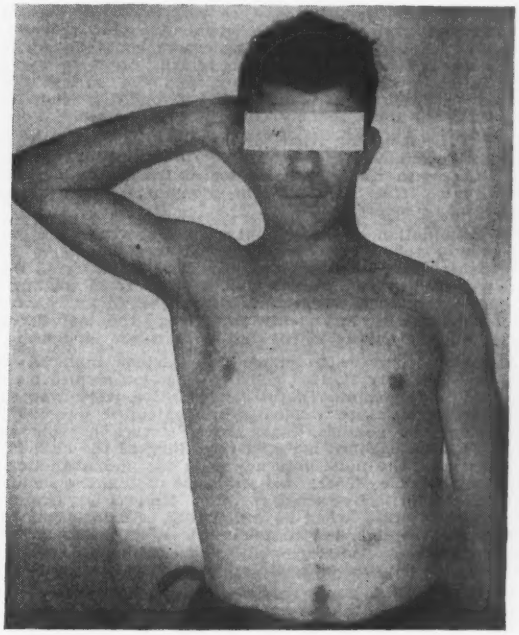

FIGURE VI.

Illustrating the range of movement regained nine weeks after acromionectomy. (This patient was not included in the series.)

abduction to 120° was still painless. The patient was last examined in November, 1949. The left shoulder had a full painless range of movement with normal strength; in the right shoulder three-quarters of the range of abduction (160°) and three-quarters of the range of rotation were possible.

CASE XVII.—A male storeman, aged forty-four years, had been involved in a motor accident in 1943, his left shoulder being injured. No fracture was detected, but four months' treatment including manipulation under anæsthesia was necessary for relief. There was a sudden recurrence of pain and stiffness early in April, 1949, which became progressively worse till he came under our notice two weeks later. On examination of the patient, the arm was held rigidly by the side, only about fifteen degrees of abduction being possible and no rotation. There was a very tender area over the greater tuberosity. X-ray examination revealed no abnormality.

He was treated by an abduction frame applied after "Novocain" injection. After a period this gave moderate comfort, but no permanent or complete relief, and the shoulder gradually became immobilized in the semi-abducted position.

Left acromionectomy, performed on June 23, 1949, revealed marked subacromial bursitis. The shoulder remained "frozen" for a further four months. Since then the pain has disappeared and most of the scapular movement has

returned, with about one-third of the normal range of scapulo-humeral movement. The patient is able to do his work adequately and shows a little greater range each time he is examined.

CASE XV.—A male machinist, aged twenty-nine years, suffered an adduction type fracture of the neck of the left humerus in October, 1945. He was treated by the application of a collar-and-cuff sling and by early movements. He had never regained full movement or had complete relief of pain since the accident. He also complained of other symptoms—nausea, pain in the knees, vomiting, belching and loss of weight—and had been under the care of a psychiatrist. On examination of the patient, there was limitation of all movements, particularly abduction. X-ray examination revealed an old fracture of the neck of the humerus, united with about 30° of adduction.

Acromionectomy was performed on June 12, 1946. Recovery was slow and the patient was reluctant to cooperate. Nevertheless a full range of movement was recovered within four months, and no definite tenderness could be elicited. There was a tendency for the movement range to regress between courses of physiotherapy, and the patient complained persistently of pain. His psychiatrist suggested that the pain was probably entirely psychogenic.

CASE VII.—A motor truck driver, aged forty-four years, was first examined in July, 1947. He complained of pain and stiffness in the right shoulder of five years' duration, following a lifting strain. The symptoms had gradually become more severe.

On examination of the patient there was tenderness over the greater tuberosity, and abduction was limited to 100° with pain. Internal rotation was limited, but external rotation was normal and painless. There was some wasting of the musculature. X-ray examination revealed fairly extensive calcification apparently involving the subacromial bursa and the supraspinatus and *teres minor* tendons.

Acromionectomy with removal of calcified material was performed on July 31, 1947. The calcification seemed mainly confined to the supraspinatus tendon. Recovery was slow and the musculature wasted. By September only 90° of abduction was possible. An X-ray picture at this time revealed some calcified material remaining in the cuff. Two months later the musculature was better and abduction to 130° was possible. There was still some pain in the shoulder, but the patient had returned to work. He was last examined in November, 1948, when he complained of a little pain and clicking in the shoulder. Abduction was limited to 130° and rotation to about three-quarters of the normal range. The patient was working and wanted no further treatment.

CASE IX.—A medical practitioner, aged thirty-two years, complained of dull pain in the right shoulder of two years' duration, and of acute pain present for two days. On examination of the patient there was considerable tenderness over the supraspinatus insertion, and the arm was held rigidly by the side, any attempt at movement being actively resisted and causing even more acute exacerbations of pain. X-ray examination revealed calcification above the greater tuberosity. Conservative treatment was attempted for two weeks without relief.

Right acromionectomy was performed on June 3, 1948, with immediate relief of pain. Movements were almost fully regained in one month and the shoulder remained painless. In the last communication from this patient (April, 1950) he states that the result remains perfect.

CASE XIV.—A male poultry farmer, aged thirty-four years, sustained a fall on the left shoulder in 1944. X-ray pictures at the time revealed no fracture, but treatment was required for six weeks and the shoulder remained painful and limited in function. The patient again sought treatment, and further X-ray films in 1947 revealed a large ununited flake fracture on the under surface of the acromion running into the acromio-clavicular joint. The patient was first examined by us in January, 1949, when abduction was limited to 100° without alteration in scapulo-humeral rhythm. Rotation movements were normal, and there was some tenderness localized to the outer end of the clavicle. Acromionectomy was performed on January 13, 1949. One month later the patient had practically a full range of painless movement. His condition was last reviewed in January, 1950, when the shoulder functioned normally in every respect.

Discussion.

The operation of acromionectomy must be considered fairly well established. Although at the present time Armstrong's series is the only group on which a report has been made, it is known that several English surgeons have for some time been making use of the procedure. The main theoretical objection to the operation is that excision of the acromion would seem to remove one of the most stabilizing factors from the least stable joint in the body. The possibility of upward dislocation following sudden upward or oblique thrusts must be considered. However, no case of this complication is known to have occurred. Actually, when the shoulder is elevated as it would be prior to dislocation, the acromion overlies very little of the head of the humerus and so would appear to have small bearing on the likelihood of this complication. Also, the combined muscle pull is much stronger downward than in any other direction.

The necessity of strong, accurate suturing of the deltoid back to its origin must be stressed. Failure to accomplish this would reduce stability and also result in considerable loss of active movement. One patient referred to us had undergone partial acromionectomy, performed for supraspinatus degeneration. The symptoms were unrelieved and there was a gap where the deltoid had pulled away from its origin. This, added to the unrelieved cuff lesion, had further reduced active abduction. Removal of the remainder of the acromion, together with resuturing of the deltoid, relieved the symptoms and fully restored shoulder function. Disarticulation of the acromio-clavicular joint does not alter function, as the shoulder remains adequately suspended by conoid and trapezoid ligaments.

The results of the operation seem good. Armstrong reports 84% of his 95 cases as being satisfactory, and in five of the unsatisfactory cases partial acromionectomy only was performed. Three of our cases were failures, and each case represented a failure of the surgeon rather than of the operation. One patient (Case XVII) had a "frozen shoulder" due to subacromial bursitis which was treated conservatively for three months. In retrospect it seems that, had the operation been performed earlier before the secondary contractures had become established, a better result might have been expected. However, this case in the final assessment may not be a failure, as improvement, though slow, is continuous and the shoulder is painless.

Case XV was badly selected. A consultation with the patient's psychiatrist would probably have prevented this error. In Case VII the cause of failure may have been incomplete removal of calcified material. In most cases this may be relied upon to be absorbed. The remaining cases were satisfactory from both the patients' and the surgeons' points of view.

Summary.

1. The indications for acromionectomy are discussed.
2. The anatomy of the acromion is described.
3. A short review of the literature is given.
4. Operative technique is described.
5. Several illustrative case histories are given.
6. Possible complications and results of the operation are discussed.

Acknowledgements.

We wish to thank the Deputy Commissioner for Repatriation, and the Superintendent of the Repatriation General Hospital, Concord, for making available some of the clinical histories.

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SURGERY IN THE FIELD.[1]

By PETER ROW,
Brisbane.

Il est impossible que le blessé aille chercher son chirurgien; il faut donc que le chirurgien se porte au devant du blessé (M. Duval).

IN this address I propose to omit much of the clinical side of surgery, and to concentrate instead on some other aspects of surgery in the field. My reason for this omission is that most surgeons working in forward areas find the actual operating the easiest part of all. On the other hand, the best surgeon in the world would be quite useless if he did not have his equipment, trained assistants and nurses to look after his patients.

OBJECTS OF FIELD SURGERY AND ITS IMPORTANCE.

Ogilvie has defined forward surgery as "the primary treatment of battle casualties". It is a branch of military surgery as military surgery is a branch of the science of war. He also reminds us that the primary object of military surgery is to restore to health the fighting soldier in order that he may fight again. Other objects are the saving of life, prevention of suffering, and the restoration to the nation of the best of its manhood, albeit a little battered. We cannot help being influenced by these latter humanitarian motives; but we must not lose sight of the primary object, since the more men we restore fighting fit, the shorter the war, and the fewer lives lost in the long run.

Field surgery is also the most important branch of military surgery, since upon its quality all that follows will depend. The work of the reparative experts further back will depend upon the standard of this early surgical treatment.

THE SITING OF FIELD SURGICAL UNITS.

You are all familiar with the old diagram depicting the scheme for collection of casualties in the field and their evacuation to the base. Where in this scheme should primary surgical treatment be carried out? If we consider past history we shall find that the surgeon operated in many different places.

In static warfare, as seen in the trench warfare of the 1914-1918 conflict in Europe, most operating was done in a special unit developed for the purpose—the casualty clearing station. It was possible to set up a "C.C.S.", or a group of them, some 15 miles from the front line, and out of the range of artillery. Nursing sisters could be employed in such a unit, and patients could be held until fit for evacuation, and then sent back by an ambulance train. The surgeons worked very hard, for casualties were numerous and their wounds very contaminated, but the surgeon surely had few tactical worries outside his job in hand.

Now let us consider the desert campaign of the last war. This was mobile warfare. Concealment was difficult and dispersion against air attack was necessary. If a "front line" existed at all it changed its position frequently. On the other hand, wheeled transport was swift, plentiful supplies of equipment could be carried, and casualties could be evacuated rapidly by road or air. The forward surgeon operated usually in a surgical team attached to the main dressing station of a field ambulance, perhaps 50 miles from the fighting. Less serious cases went to the casualty clearing station still further away.

In the garrison of Tobruk primary surgery was performed in a general hospital. In the case of jungle warfare it was different again. Here there was no swift movement. Men moved painfully on their feet. Equipment had to be carried by the troops or native carriers, or delivered by parachute. It was a war of ambush, of fighting patrols, of cutting *kai* lines, and consequently the lines of communication were often precarious. Here one found the surgeon working in an advanced dressing station or further forward in a "medical post" of a field ambulance. He served a single battalion, perhaps a single company. He was close to the fighting, but well concealed from the air. Sometimes he had to nurse his patients for weeks as there was no way of evacuating them.

In the case of beach landings primary surgery was carried out in an "L.S.T.", "L.S.I." or hospital ship, or on the beach itself. In air-borne operations the surgeon and his equipment were dropped from the skies.

Is there any guide to help us in the siting of the forward surgical post? We have seen that in practice it is placed in different units, and at different levels. The answer is a matter of time rather than distance, and it is really a problem in pathology.

In the first place, in order to get the best results most wounds should be treated operatively well within twelve hours. Some serious wounds involving abdominal hollow viscera will be fatal unless they are treated within twelve hours. During the six to twelve hour period after receipt of the wound, contamination becomes infection, penicillin and other drugs notwithstanding.

In the second place, a number of seriously wounded men must be held for seven to ten days before they are evacuated.

Of course, these two exacting requirements cannot always be met. The tactical side is all-important; but if the surgeon knows just what is required, then he is more likely to obtain it.

The field surgeon should always have a special column in his operation book in which is recorded the number of hours elapsing between receipt of the wound and treatment. Such simple statistics will be helpful in tracing delays, and will assist the assistant director of medical services or field ambulance commander in correctly siting surgical posts.

THE FORWARD SURGICAL UNIT.

The establishment, organization and scale of equipment of a forward surgical unit have never been settled and probably never will be. The casualty clearing station is really designed for such work, but in the recent war it often became a hospital on account of its unwieldiness. Primary surgical treatment was carried out in most cases by surgical teams attached to field ambulances, or by special units designed for the purpose. However, I do not propose to compare the advantages and disadvantages of these different units. I shall keep to general principles.

The Personnel.

Let us first consider the personnel, and first of all the surgeon himself. He must be physically fit and an experienced surgeon.

Though much forward surgery consists of humdrum dressing of wound after wound, now and again a problem is encountered which may demand the best possible judgement and skill. It is no use having a half-baked surgeon in charge of a forward operating post. The surgeon should also be wise in the ways of the army. He should certainly know something about field ambulance work, and he should understand the way the army "ticks"—"G", "A", "Q" *et cetera*.

There are a number of undesirable types of field surgeon. Ogilvie once produced a list of them. I have forgotten the details, but it goes something like this: (i) The tortoise. The field is no place for the surgical tortoise. He is a scratcher and a procrastinator, and merely wastes time. (ii) The slasher. This type believes that field surgery is plain butchery, and since bombs and bullets are no respecters of anatomy, neither is he. (iii) The death and glory boy. He would rather operate on one potential corpse than ten good soldiers. (iv) The record breaker. He is closely allied to (iii) above. He is out

[1] Read at a meeting of the Section of Naval, Military and Air Force Medicine, Australasian Medical Congress (British Medical Association), Seventh Session, Brisbane, May-June, 1950.

to break records for the number of feet of intestine resected and so on. (v) The super specialist. This person's mind is so specialized that he has lost all sense of proportion. He will spend all day performing a craniotomy while casualties pile up and wounds grow infected.

Let us now consider the surgeon's assistants. These fall into two groups.

1. Qualified assistants. These are medical officers who assist the surgeon, supervise anæsthetics *et cetera*. There is little more to be said about them except to agree with Orme Smith that they should be no more than assistants. Two equally eminent surgeons do not work well in double harness as a rule. It is better that there should be no doubt who is master and who is "stooge".

2. Unqualified assistants. These are the trained operating theatre orderlies and nursing orderlies. They also need to be physically fit, and they should be intelligent and interested in their jobs. Disgruntled men with bad feet are often offered as reinforcements to medical units, but they are seldom of much use. In my experience the man who ran the local ambulance in his home town knows too much to be trained, though there have been brilliant exceptions. Previous occupation does not matter a bit. Some of my best orderlies have been farmers and omnibus drivers. Bushmen who can swing an ax and do rough carpentering are particularly useful, and they make gentle, efficient nurses.

The correct training of the orderlies is most important. They need the "barrack square stuff", field ambulance training, and more specialized training in wards and operating theatre. The last-mentioned is best provided by their attachment to a base hospital; but somebody must watch their interests, otherwise the sisters will "sit on" them and keep them scrubbing floors instead of "scrubbing up" and nursing patients.

Tactical training of the whole forward surgical unit is also important. The unit (or team) should be included in brigade and divisional exercises, and it should get to know the field ambulance with which it will operate.

Nursing orderlies are all-important. The chief weakness of the average surgical team was its lack of experienced nursing orderlies. Good surgery can be wasted if nursing is below standard.

Equipment.

The scale of equipment of a surgical team contains pretty well everything which may be required, while the surgical equipment of a casualty clearing station is quite lavish. Trouble arises when it is not possible to carry all the equipment and things have to be left behind. My minimum equipment has been six "boy loads" (about 180 pounds) excluding tentage. The surgeon should have made up his mind beforehand what items he will discard when he is obliged to "travel light". He should make sure that he takes a good light. Ether is heavy, awkward stuff, and far too much is carried as a rule. Approximately 50 "Pentothal" anæsthetics are given for every three ether anæsthetics. It is not necessary to carry a great deal of catgut either. It is bulky, and most operations can be performed quite well with the use of silk, linen or cotton thread as the sole suture and ligature material. One should be certain that an efficient apparatus for the aspiration of chests is available before setting out. This is most important.

It is not possible to say more about the equipment in the time available, but a word about its packing will be worth while.

First, one should thoroughly mix up all the "Q" medical and ordnance stores, and then pack them according to one's own tactical needs. This procedure will horrify the officer commanding medical store and the quartermaster, but it cannot be helped. The containers used will depend on the type of warfare—for example, panniers for road transport, bondwood boxes for native carriers, and special containers for air dropping. Whatever kind of container is used, the equipment should be tactically packed so that all the eggs are not in the one basket and all the baskets are not in the one vehicle. Instrument bundles, anæsthetics, important drugs, dressings and some liquid fuel should be distributed over a number of containers, so that the loss of a box or a vehicle may not mean disaster.

Finally, it is important that members of a surgical unit should know their equipment as the fighting soldier knows his weapons. They should pack and unpack it many, many times, and they should use it frequently during training.

The Forward Surgical Unit at Work.

Relations with Other Field Units.

The surgeon and his team may find themselves attached to a field ambulance, and they will often depend on such a unit for rations and for much assistance with resuscitation, anæsthetics and nursing. The members of the team will endear themselves to the ambulance personnel if they willingly help with the routine work of the parent unit when surgery is lacking. There is no room in the field for the aloof specialist. The surgeon should be prepared to give a hand with the sick parades or look after the dysentery ward if needed, and if his own department is quiet.

Sorting and Resuscitation.

"Sorting" or "triage" should be in the hands of an experienced medical officer working in close collaboration with the operating surgeon. This is a difficult task, since priorities have to be adjusted continually as fresh batches of casualties arrive.

The subject of resuscitation is too vast for this paper, but I should mention that transfusions can be overdone. If the patient is fit to travel to the surgical post, he should be given morphine and moved along. Blood transfusion is best given on the threshold of the operating theatre unless the patient is too ill to be moved without it. Unnecessary blood and serum transfusions further forward will cause delay. Moreover, the patient does not seem to respond so well to his second resuscitation as to his first.

Rate of Work.

The rate of work of an average field surgeon will surprise some of you. He can perform twelve average operations in twelve hours. This figure is useful when one is calculating one's needs in personnel. I first heard it quoted by Lieutenant-Colonel T. Ackland.

Statistics.

The field surgeon should keep his own rough statistics as he goes along. These figures are useful in assessing the "expendables" required per 50 or 100 casualties.

As an example, I sorted over 200 consecutive battle casualties in jungle warfare. Among each 100 casualties there were ten compound fractures of the femur (the most time-consuming cases) and twelve chest wounds. In eight of the latter cases hæmothorax developed and regular aspiration was required. There were five abdominal wounds requiring laparotomy and fourteen compound fractures of the legs. These latter included the most troublesome cases, as hæmorrhage deep in the leg can be tiresome, and tension within its fascial compartments invites disastrous infection. Only three or four major amputations were encountered and one "acute appendix" required removal. There were no major burns in this series as we had little or no petrol.

From such figures as these one can work out on paper one's requirements in terms of Thomas splints, drugs and dressings.

Progress in Field Surgery.

Field surgery has advanced a long way since the time of Ambroise Paré. A great deal of progress was made during the last World War. The conflict of 1914-1918 ended with certain sound practices well established, among them being the excision of all but trivial wounds as early as possible, the routine injection of antitetanic serum, and

the widespread use of the Thomas splint for collection, evacuation and treatment in cases of compound fracture of the femur. The value of blood transfusion was also well understood. In the period between the wars the Winnett Orr treatment of osteomyelitis became popular. The idea was to establish free drainage, avoid frequent dressings, and provide uninterrupted rest in a plaster cast.

The method was applied successfully by Trueta to war wounds during the Spanish Civil War. We commenced the last war convinced that it was the answer for evacuation and treatment alike. The method was a great success, especially for evacuation of certain casualties, though tragedies did occur when free drainage was not provided and surgical toilet was incomplete. It was necessary to watch the peripheral circulation, and insufficient vigilance could allow a plaster cast to conceal a warning hæmorrhage or the local signs of gas gangrene. Many of us considered it a highly dangerous business to evacuate a patient in a plaster cast which was not split.

Soon it was realized that the surfaces of plaster casts teemed with pathogenic organisms, making cross-infections almost inevitable; but about this time the influence of the plastic surgeons was being felt. They convinced us that it was not desirable to leave raw areas. Disability could be reduced if clean wounds were covered with epithelium as soon as possible by means of delayed primary or secondary suture or early grafting.

The arrival on the scene of penicillin aided by sulphonamides and new members of the acridine antiseptics made these procedures commonplace. Even primary suture was possible occasionally under ideal conditions. The widespread use of whole blood, plasma and serum saved many lives; but soon we were to realize that, quite apart from the saving of life, if we kept up a patient's hæmoglobin value by transfusion of blood and gave him plenty of protein, he beat his infection and his wounds healed more rapidly.

We may safely say that, given a good system of evacuation and a secure supply line, the wounded man has a far better chance nowadays than formerly, though much still depends on those who carry him to the surgeon in good time.

Conclusion.

Finally, I should like to say a word or two about retreats or "strategic withdrawals" as they are so commonly called. When we are advancing the military machine works fairly well, even if it does creak a little. Our plans have some chance of success as they are not continually upset by the enemy. We are able to do clever things such as the delayed primary suture of wounds, and we may hold our patients for a while before evacuating them. Our best results of treatment of war wounds are obtained from advancing formations. I do not wish to be pessimistic, but would remind you that, though we British always win the last battles, we are invariably pushed around during the first few. It is much more difficult to attend the wounded when we are withdrawing. Our technique of treatment of wounds must be modified accordingly. We must not make the mistake of working out everything on the assumption that we shall always advance, and I think that I can detect such a tendency in recent articles dealing with the management of the wounded.

Most of what has been said has been based on the experiences of the past, and it can be argued that future wars may be very different. They may be push-button affairs with the air full of strange radiations and bacteria. The principles will remain the same, but they will need modification. We must learn how to deal with atomic injuries and how to protect our patients and ourselves from these terrible weapons.

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AVIATION MEDICINE: ITS SCOPE AND APPLICATION.[1]

By Lockhart Rait, Flight Lieutenant, Royal Australian Air Force, M.Sc. (Adelaide), M.B., B.S. (Melbourne), B.Sc. (Tasmania),

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Medical aviation from a comparatively small beginning now covers a very large field, involving nearly all the scientific and medical specialties, and it has now reached a status that justifies the formation of a medical aviation section of the British Medical Association.

To understand the development of aviation medicine it would be necessary to outline the development of aviation itself, since one is so intimately fused with the other. Prior to the recent war practically one-half of the literature on aviation medicine was concerned with a single subject—namely, anoxia or oxygen lack. This has often been the case during the infancy of other medical specialties; as an instance of this, let me suggest that the modern science of biochemistry had its infancy in the study of diabetes, and reached maturity as an established science with the discovery of insulin.

Aviation medicine had a rather difficult birth. Priestley and Scheele independently discovered oxygen in 1774; and it was not long before oxygen was demonstrated to be the most vital of bodily requirements, whose removal from the environment would soon produce death in the higher organisms. The celebrated flight of Tissandier and his two companions in 1875 may be said to be the stage at which aviation medicine "went into labour". These intrepid airmen were the first to carry oxygen during a balloon ascent into the upper atmosphere, and as is generally known, the need for the oxygen did not become manifest to the fliers until they became helpless and all of them had been overcome. Only Tissandier returned to earth alive. The others were dead and the oxygen was unused—a story which was to repeat itself again and again down through the years, and one which continues to be repeated even to this very day. As you may well see, the effects of oxygen lack had been known to science during the past century, and it was apparent to the early pioneers of aviation that with increasing altitude oxygen lack became more real. It has been only during the past twenty-five years that aircraft have been fitted with suitable oxygen equipment and its use has been fully appreciated. Yet, it may seem strange to relate, even during the late thirties of this century pilots were still ascending to altitudes in excess of 20,000 feet without wearing an oxygen mask, and today we still find a few of the older pilots who have not become fully oxygen-conscious.

Paul Bert's original work with reference to the importance of the partial pressure of oxygen in the inspired air produced a storm of criticism from some contemporary physiologists.

Therefore, in common with other worthwhile discoveries in medicine, aviation medicine has grown from a soil impregnated with suspicion and scepticism; but its

[1] Read at a meeting of the Section of Aviation Medicine (British Medical Association), Brisbane, May-June, 1950.

flower has not been born to blush unseen, for today it is an established science.

Many of us in our student days have turned over the pages of some very large tome in order to gauge the scope of a subject before us. I propose in this address to turn over the pages of aviation medicine so that you will be able to see its scope and practical application—for indeed, if I can do no more than this, the object of this introduction to aviation medicine will be achieved.

Aviation medicine will be always a necessary study, since flying will always be associated with the potential dangers of speed and the defiance of the law of gravitation.

Successful aviation is like the fool's (Jaques's) melancholy, a complex of complexities, and requires the cooperation of engineering, medical and human knowledge and skill at its best.

Not only have we to understand the complicated interreactions of man to an ever-changing environment at ground level, whether on land or in water, but once above the ground he has to adapt himself to many other variables, a combination of the fluctuating conditions created by the atmosphere and his aircraft.

Man is a terrestrial animal, and his body is designed to live and work near the ground. The body will continue to perform reasonably well under conditions beyond its normal limits, for it is endowed with a wide range of adaptation; but outside these limits it ceases to function. Stresses encountered during flight may far exceed these boundaries; but if they are recognized, and if proper use is made of special techniques and special flying equipment, it is possible within reason to exist under almost any conditions. It is the aim of aviation medicine to study these limitations, and to develop these special techniques and produce these various aids to counter the conditions which are beyond man's own natural power of adaptation.

THE PILOT.

First and foremost we must consider the pilot, who for all practical purposes is the human link in the mechanism of aircraft control. He has, of necessity, to be selected after careful examination and testing, both physiologically and psychologically, as to his ability to cope with, and "stand up", to the stresses and strains encountered during flight; in other words, he must reach a high standard of physical and mental fitness. Time will not permit me to deal with these various examinations and tests and their physiological and psychological significance and interpretation; but it must be apparent to you that certain senses, such as vision, hearing and sense of equilibrium, must be above average, for without a wide range of accurate vision by day and night, an accurate interpretation of auditory signals, and a stable sense of equilibrium, man cannot fly, no matter how skilled or practised he may be.

During his initial training the pilot must be taught the principles of aviation physiology by lectures and demonstrations, and by his own performances under simulated conditions of acceleration, anoxia, reduced pressure, temperature, darkness *et cetera*. Upon the ground he not only learns the limitations of his own body, but demonstrates to his instructors his fitness to undergo these experiences in actual flight.

The successful pilot must also have a combination of certain mental traits that all go to give what for a better term we may call "flight sense"—a special form of intelligence that gives the greatest speed of reaction and action to some sudden emergency; this is a quality difficult to estimate, but nevertheless essential. As yet we do not know with exactness the psychological make-up of the perfect pilot, but experience has shown that certain undesirable features preclude the acceptance of candidates for flying duties.

THE AIRCRAFT ENVIRONMENT.

Let us consider the aircraft. The pilot is obviously the most important person in the aircraft, and human factors must be considered in aircraft design. The closest cooperation between designers and medical advisers should take place, so that the interrelated factors which influence the efficiency of the pilot and the safety of his aircraft may be considered, and the aircraft constructed to give the most satisfactory operating conditions. Among some of the more important of these factors are the following: (i) the cock-pit design and layout, which include comfort and a safe seat, built to anatomical requirements; (ii) the designing of the windshield to give the best angle of visability for comfort and efficiency; (iii) the cock-pit and instrument layout, constructed to give the correct physiological distances and lighting to prevent undue visual fatigue; (iv) the setting of the controls so that they can be felt easily, and so that they are reachable in all the attitudes the aircraft may assume in flight; (v) the general factors of cock-pit comfort, the damping of noise and vibration, ventilation, warmth, humidity, avoidance of glare, and that ease of movement essential to give mental and physical relaxation; (vi) lastly, the question of design in order to give the maximum margin of safety—the position of release hatches, the fitting of safety belts, and with modern aircraft the major problem of automatic ejection.

THE CONDITIONS OF FLIGHT.

Let us now turn over the pages and consider the conditions of flight. In flight the pilot has to adjust himself to three major sets of variants: (*a*) those produced by the aircraft; (*b*) those produced by the interreaction of his aircraft with the external environment; (*c*) those imposed by direct contact with the external environment.

The conditions created by the aircraft itself and those produced by its interreaction with the external environment are closely interrelated; for convenience these may be considered together. Among the more important of these effects are noise, vibration, acceleration, toxic fumes, glare and other changes of visibility due to rain or frost settling on the wind shields.

Initially they are brought about by the power units and the aircraft's movement through the atmosphere, during the latter's fluctuations of temperature, pressure and moisture, which give variations of fog, cloud, rain, wind *et cetera*—in other words, what the pilot calls "the weather".

Noise.

Noise is a source of irritation to the pilot, and not only does it affect his hearing, but his other bodily functions may be disturbed by it.

There are four kinds of noises in an aircraft during flight.

1. The engine noise due partly to mechanical factors and partly to the exhaust.

2. Aerodynamic noise coming from two distinct sources: (*a*) the aeroplane itself, in its passage through the air, and (*b*) the airscrews.

3. The structural noise—a direct result of the noises from the above two sources. It consists of vibrations in the airframe, brought about directly or indirectly by transmitted engine or aerodynamic noise.

4. The residual noise. This is of minor importance, and is brought about by the operation of various services in the aircraft, and is normally present only under special circumstances.

Aircraft noise may be counteracted to some extent by carefully designed helmets and ear defenders; but in the main the noise must be reduced at its source, and its entrance into the aircraft reduced to a minimum. This is a major problem in aircraft design.

Vibration.

The aircraft, in whole or in part, is set into vibration by forces which arise from the air and from the engine. These vibrations are propagated to the various parts of the aircraft and affect that part of the pilot's body which is in contact with the aircraft. In summation these effects

accelerate general fatigue. The problem of damping is again one of aircraft design.

Acceleration.

All forms of acceleration—linear, angular and centripetal—may be produced singly in flight, but they occur most often in the most varied combinations. These accelerations will affect the pilot's cardio-vascular system to a lesser or greater degree, depending upon the following factors: (i) the magnitude of the acceleration; (ii) the period during which the acceleration is effective; (iii) the direction of application; (iv) the bodily condition at the moment of application. Linear acceleration usually causes no sensations, except the feeling of increased pressure on the back of the body. Angular accelerations generally are minor in effect, but may produce vertigo; however, accelerations beyond a certain limit in a curved path will bring about loss of the sensory functions and finally coma.

Special suits have been designed to counteract these effects, notably, the "Cotton suit" designed in Australia during the last war. In this connexion it is worth while mentioning that with modern high-speed aircraft flying at high altitude these suits are no longer a requirement, since aerodynamic factors prevent the attainment of large centripetal accelerations. Nevertheless, apart from the assistance of physiological aids, experience has shown that the pilot's ability to tolerate high degrees of acceleration will be diminished by his lack of physical fitness.

Toxic Fumes.

Toxic gases may arise in an aircraft from such sources as exhaust gases, fire extinguishers, gasolene, oil, cooling fluids, refrigerant fluids and hydraulic fluids. These may have injurious effects on the pilot to the extent of producing collapse—for example, carbon monoxide. Experimental work has been done over the past few years to determine the most effective means of detecting and clearing vapour from aircraft. These are problems which enter the field of the physicist and chemist.

Glare and Wind-Screen Visibility.

The design of anti-glare goggles and wind screens, and the further mechanisms for defrosting the wind screen and preventing its being blurred from rain *et cetera*, have greatly reduced eyestrain—a potent factor in inducing fatigue.

Canada's new rain repellent, "F.C.10", a waxlike substance rubbed on aircraft wind shields, reduces optical errors and allows normal visibility of two miles in rainstorms.

The Effects of the External Environment on the Pilot.

Under the heading of the external environment and its effects on the pilot we find some of the major physiological problems of aviation—the problems associated with flight at high altitudes; for example, the study of the action and counter-action of the effects of anoxia, low ambient pressures and cold, and the problem of darkness which occurs at all altitudes.

Anoxia.

I have already referred to the extensive literature that surrounds the subject of anoxia—one of the utmost importance to all personnel engaged in high-altitude flights.

Anoxia is the state resulting from a lack of oxygen in the blood and other tissues. Human metabolism is adapted to sea level and slightly above. Within this range the blood is nearly saturated with oxygen. Under such conditions, oxygen lack is rarely a problem. As altitude increases oxygen saturation of the blood decreases because of the reduced atmospheric pressure.

The electrocardiograph may reveal anoxic changes in heart muscle at an altitude as low as 5000 feet, and slight subjective symptoms of oxygen lack may appear at 6000 feet. Between 6000 and 8000 feet retardation of the emptying time of the stomach may be demonstrated, and at 10,000 feet changes in visual acuity are apparent.

The danger of anoxia first actually arises between 10,000 and 20,000 feet, and from then upwards becomes an ever-present peril.

To maintain efficiency auxiliary oxygen must be used above 10,000 feet, and under special circumstances it may be necessary at lower altitudes; but at 37,000 feet, despite the use of a supply of pure oxygen, anorexia begins to develop owing to the reduced partial pressure, and the limit of consciousness during the breathing of pure oxygen is not far in excess of 45,000 feet.

For practical purposes above 42,000 feet the partial pressure of oxygen in the atmosphere is so low that oxygen must be supplied under pressure.

The most sensitive part of the body to oxygen lack is the brain, and because of this mild degrees of anoxia may impair self-criticism and judgement to such an extent that the early bodily symptoms and signs of anoxia are often overlooked. There are considerable individual variations in reaction to lack of oxygen. Apart from acclimatization to altitude, these differences appear to be associated with the differences in sensitivity of individual respiratory centres. Nevertheless, it has been shown that a critical altitude exists at which the mean value for the duration of consciousness is no longer distorted by exceptionally resistant subjects. Beginning from this point, a section of the response curve relating altitude to consciousness is a straight line. Under conditions favouring the maximum resistance to anoxia the critical altitude is 26,000 feet. Here, nine out of ten subjects were helpless within five minutes, and the average time to helplessness was 220 seconds.

For each thousand feet increase in altitude between 26,000 and 32,000 feet the duration of useful consciousness decreases by approximately twenty seconds. This, I think, is the most important lesson of all—the realization that when oxygen is not being used at altitudes or when the oxygen equipment fails there exists this period of useful consciousness beyond which it is impossible to act, and the fatal error of Tissandier and his companions will be repeated.

Devices to give the pilot warning within this period have been considered, and more recently a minute electroencephalograph has been designed with the head electrodes incorporated within the pilot's helmet; the cables leading from the electrodes plug into a warning box in an arrangement similar to that used for earphones. It is held that this instrument will indicate anoxic changes in the brain and give the pilot an early warning.

Low Ambient Pressures.

When man is exposed to low pressures, his speech, sight, hearing, pain sensitivity and mental reactions are all influenced. The extent to which they are affected depends on the altitude and duration of exposure. Above 30,000 feet a condition of gas formation known as the "bends" or decompression sickness becomes a complication. Some writers refer to this gas formation as "aeroembolism"; it is a condition produced by exposure to low atmospheric pressure, and is characterized by the formation of bubbles consisting of nitrogen, oxygen, carbon dioxide and water vapour in the tissues. At sea level the tissues of the body are saturated with atmospheric nitrogen. As atmospheric pressure is decreased, nitrogen is given off in the lungs, and the nitrogen in the tissues begins to enter the bloodstream. In ascents to altitudes above 30,000 feet the amount of dissolved nitrogen is in excess of that which can be held in solution, so the nitrogen gas will come out of solution and form bubbles, to which are added some oxygen, carbon dioxide and water vapour from the surrounding tissues. These bubbles are formed not only in the blood, but also in other tissues. It is generally believed that the formation of these gaseous bubbles is in some way responsible for "bend pain", but the mechanism is not yet clear. It must be clearly understood that the word "bends" designates one symptom of a clinical syn-

drome having many manifestations, from mild joint pains to fatal coma, arising from embolization of the cerebral circulation or the presence of gas in the cardiac chambers.

Expansion of Bowel Gases.

Another effect of high altitude flights is the ballooning of the stomach and the intestines due to the expansion of the contained gases. This tends to occur especially in those who have lax abdominal walls and suffer from fermentive digestion. This ballooning leads to an unpleasant pressure on the abdominal walls and diaphragm, and if the distension reaches serious proportions, as it frequently does, it may cause discomfort of a dull aching or cramping nature, and further, may hinder the descent of the diaphragm, thus decreasing the normally available space of the thoracic cavity and resulting in respiratory and cardiac embarrassment. Further, in prolonged flight, if this trapped gas cannot be expressed by natural means, the pressure from within the intestinal loop may conceivably cause pressure on the intestinal mucosa within this segment, leading to localized ischæmia and perhaps pronounced derangement of digestion. If this condition should persist for hours, an effect similar to that of intestinal obstruction may obtain, with loss of peristalsis and retention of intestinal content, possibly leading to the absorption of toxic products from the paralysed segment. Therefore, high-altitude personnel must be educated about the mechanisms of the production of gas and about those foods and mannerisms of eating which foster its development. This is partly a problem in dietetics. At an altitude of 55,000 feet dissolved gases and water vapour inside the body expand and cause the skin to swell; and at 63,000 feet, if this expansion of gases and water vapour is disregarded, the blood is known to boil at normal body temperature. Although man has ascended to altitudes in excess of 70,000 feet, he has done so only in pressurized compartments. The dangers involved in pressurization system failure or in forced "bale-out" at high altitudes are obvious. At extremely high altitudes, even in a pressurized and air-conditioned environment, consideration must be given to other effects, such as the influence of ultra-violet solar radiation and cosmic rays.

Cold.

With increasing height above sea level, the temperature of the air falls on an average 6° C. for every 3200 feet elevation to the stratosphere. Above this the air temperature is uniform throughout the year at – 50° C. to – 60° C. Therefore at high altitudes the pilot must be protected by special clothing against undue loss of heat and frostbite. However, clothing alone will not protect the body at very low temperatures without adequate oxygen, because the loss of heat from the lungs alone by conduction and vaporization will be in excess of what under the circumstances the body can furnish. The prevention of exposure to cold is a factor which it is within the sphere of the engineer to control and remedy.

Darkness.

The hazard of darkness, of course, cannot be overcome, but night vision may be improved by the understanding of special techniques, such as the factors which produce dark-ground adaptation, and by its maintenance by controlled cock-pit and instrument lighting. The study and design of various ground devices such as beacon and runway lights are also of extreme importance, for without these aids it would be impossible to land safely by night.

CONCLUSION.

We have covered rather briefly some of the aspects related to pre-flight and flight, but there still remain other large fields for exploration, concerning man's reaction to environmental conditions outside the aircraft either at height during bale-out or at ground or sea level after "ditching" or forced-landing. The problems associated with bale-out at high altitude, especially from aircraft travelling at high speeds, are full of difficulty; for instance, even if we make the dubious assumption that the pilot should jump or be ejected clear of his aircraft, and that he would survive bodily shock, there still remains a serious temperature problem, for upon abandoning the aircraft at high altitude, a pilot would be subjected to sudden temperature changes. After a few seconds he would have slowed down sufficiently to experience a temperature close to – 60° C. Just how he would dress and meet this emergency is one of the many problems future aviation medicine must face.

There is no area of the earth's surface over which man does not fly, and the problems of his survival, apart from injuries sustained, will depend largely on the climate and area in which he may find himself. Various techniques have been adapted to air survival in the tropics, in the jungle, in the desert, in the hot and cold waters of the oceans and in arctic and antarctic snows.

Then there are the major problems of flying fatigue, and of when a man is too old to fly, and the whole question of safety devices and procedures, and the investigation of the causes and means of preventing aircraft accidents.

In conclusion, modern aviation medicine is, in general, a special field of preventive medicine that has as its objective the prevention of aircraft accidents. This it does by the scientific selection and maintenance of the flyer so that at all times human error is reduced to a minimum, and by advising the engineer so that aircraft design will allow for the factors of anatomical structure and the physiological limitations of human function; thus both the aircraft and the flyer will be "flying fit" and "fit to fly".

TUBERCULIN IN DIAGNOSIS AND TREATMENT.[1]

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THE use of tuberculin is based on the discovery, made by Robert Koch in 1890 in guinea-pigs, that a healthy animal reacts in one way and a previously infected animal in a different way to a hypodermic injection of tubercle bacilli.(1) He found that this different method of reacting occurred in man also; he could elicit it with dead bacilli or with products of tubercle bacilli as well as with live bacilli.

It has since been named "Koch's phenomenon".

It is the prototype of allergy.

In 1906 Clemens von Pirquet coined the word *"Allergie"*, later anglicized to allergy, as a name for it: von Pirquet referred specially to Koch's phenomenon, but overlooked a previous similar observation by Edward Jenner in 1798 in the case of vaccination.(2)

Tuberculin in Diagnosis.

Koch's phenomenon is exploited in diagnosis by the use, not of tubercle bacilli alive or dead, but of a filtered and boiled extract of tubercle bacilli, called tuberculin, or, to distinguish it from later products, old tuberculin ("old T."). It has the disadvantage that it contains some of the protein of the medium in which the tubercle bacilli were grown, and this foreign protein may give rise to minor reactions. Tuberculin made from cultures on media containing asparagin, in place of beef protein, is free of protein and of albumose and is known as *Albumose freie Tuberkulin* ("T.A.F.") or purified protein derivative ("P.P.D."). (Koch produced "T.A.F." shortly before his death in 1911.)

[1] Read at a meeting of the Sections of Public Health, Tuberculosis, Tropical Medicine and Industrial Medicine, Australasian Medical Congress (British Medical Association), Brisbane, May-June, 1950.

When "old T." or "T.A.F." or "P.P.D." is applied to the normal body it is inert, but on cells made sensitive by *tuberculous infection* it acts as an antigen and stimulates a specific response, the production of antibodies whose effect is observable.

This response, the *tuberculin reaction*, is discussed with great elaboration by Camac Wilkinson.[3] Reference will be found also in other places.[2][4][5][6]

The ordinary British opinion is expressed in an editorial answer to a question in the *British Medical Journal*.[7]

Tuberculin may be applied in different ways: (*a*) the original subcutaneous, (*b*) the conjunctival, (*c*) the *percutaneous by inunction* or by plaster, (*d*) the intracutaneous. The last is the one now most often used; though called "Mantoux" it is still only a variety of Koch's *tuberculin test*.

If the subcutaneous test is exploited with due precautions—that is, not in a febrile patient, especially not in a meningitic—but with freshly prepared material, in adequate dose and with asepsis, it is the most helpful, for a local reaction at the *site of injection* (a hard, red, hot, painful swelling) shows that the patient has been infected *with tuberculosis*; a general reaction (headache, malaise, fever) shows that the infection is still active; and a *focal* reaction, if it occurs, shows where in the body the tuberculous infection is.

The focal reaction consists of pain and increase of *symptoms, thus*: (i) in lung disease of cough and expectoration; (ii) in iridocyclitis or congestion of *ciliary* vessels, and of turbidity of iris and of anterior chamber; (ii) in a gland or *joint of swelling and redness*.

If the evidence of reaction is so slight as to be doubtful, a repetition of the same dose two days later will produce, in an infected person, a more definite reaction; this increase of sensitiveness is most characteristic.

If the patient has been rendered tolerant by previous injections of tuberculin he will not react; neither will one who, by the severity of his disease, overwhelmed with his own tuberculin, is too ill to respond; of course, such a one should not be tested.

The intercurrence of an acute exanthem may interfere with the tuberculin reaction.[8][9]

The methods of preparing and administering tuberculin and of interpreting any reaction are described at length in a special article published in 1931.[10]

That the tuberculin reaction is specific is now generally admitted by physicians. It is emphatically asserted by Camac Wilkinson.[11] Pagel, Simmonds, MacDonald and Fatti state that the tuberculin reaction is specific[12] and that the test has an important place in diagnosis.[13] Maurice Davidson[14] states that a positive skin reaction to tuberculin indicates that infection has occurred. Eric Urbach[15] states: "The specificity of the tuberculin reaction with Koch's old tuberculin is now almost universally recognized." Arnold Rich[16] and Topley and Wilson (and Miles)[17] concur. H. W. Wunderly[18] speaks of it as conclusive both in children and in cows. W. F. Gaisford[19] is of the same opinion. The Australian Repatriation Department uses it habitually, and the medical officers appear to regard it as of great importance, as does Kempson Maddox.[20] In animals, veterinary surgeons use the tuberculin test with confidence.

In the report of the Department of Agriculture of New South Wales for the year ending June 30, 1947, it is stated, at page 26, that 22,002 head of dairy cattle were tested with tuberculin and 265 reacted—that is, 1·2%. Of other cattle 5641 were tested.

The corresponding numbers for the next year were: dairy cattle 22,964 with 238 reactors—that is, 1·03%; others 9374. In the case of 23 of the 238 reactors no lesion was found *post mortem*.

In a personal communication on January 25, 1950, the Senior Veterinary Officer of New South Wales kindly told me, and allows me to quote, that the tuberculin used was of a bovine strain prepared by the Commonwealth Serum Laboratories at Royal Park, Melbourne; that there was not opportunity at the abattoirs for a full post-mortem examination, so that a minute lesion might easily have been overlooked; and *that it was considered* that the test was at least 95% (probably 96%) accurate.

No cattle were treated with tuberculin.

The Department tests also birds, using an avian strain.

Topley and Wilson[21] consider the tuberculin test in cattle very good, though not perfect. *Arnold Rich*[22] concurs.

A reaction to *tuberculin shows that the* patient suffers from tuberculosis; it does not show that he has no other illness; the cautious physician will be wary of this possible mistake.

It is not claimed that tuberculin in diagnosis is absolutely *certain; though specific the* reaction shares with all other biological—and, indeed, all physical—phenomena the possibility of error. Diagnosis is so difficult that a combination of all means is *required. The wise physician* will seek the cooperation of the pathologist and of the *radiologist*.

Some allege that a tuberculin test is risky; with due precautions it is not. Even if there were risk in exploiting it, such risk would be *negligible in comparison with* the risk of failing to recognize tuberculosis at an early stage.

It is said[23] that in *Europe tuberculosis is* universal among those of middle age, so that in them a "Mantoux" *is useless; but in* Australia tuberculosis, though common, is not universal, and a tuberculin survey, *especially if the* subcutaneous test is employed, is of real value. It will disclose *early tuberculosis in some* patients with vague ill health of unknown cause, and in some kinsmen or housemates of consumptives even before the skiagram shows tuberculous shadows.[24][25][26][27]

Tuberculin in Treatment.

The ideal treatment of pulmonary tuberculosis consists in a combination of the sanatorium and tuberculin methods; so said Robert Koch in 1901.[28] Wilkinson echoed this:[29] "The ideal treatment is specific treatment combined with those general methods adopted in the sanatorium."

The reckless use of tuberculin may be potent for evil. Koch said,[30] "I desire earnestly to dissuade anyone from using the remedy in a conventional and indiscriminate way"; and again,[31] "the remedy may be dangerous in too far advanced cases".

Such warnings have been repeated again and again, also by the present author.[32]

Let us then consider the cautious therapeutic use of tuberculin by an experienced physician.

He will assure himself that the patient's temperature does not rise beyond 99° F. in its daily excursion. If there is mild fever it may be due to mild chronic tuberculosis readily amenable to tuberculin in very small doses, too small to affect the focus; or it may be the first symptom of acute tuberculosis inevitably mortal before the advent of streptomycin. Tuberculin in small doses will not harm such a one, but if used it would be blamed. It is wiser to refrain in the presence of fever.

Of recent years some patients with acute tuberculosis have been saved, temporarily at least, by streptomycin; later they may receive great benefit from tuberculin.

Our physician will not use old tuberculin, but one or more of several varieties such as are enumerated in the "Transactions of the Australasian Medical Congress, Sydney, 1911".[33]

Where possible, as in the skin, eye, larynx, joints or glands, he will observe the inflammatory reaction around the focus and take it and any fever as his guide.

His object will be to evoke an active immunity. This is easiest in those who are suffering from early disease and are probably still strong and active. They are supersensitive to tuberculin and respond readily; injections at intervals of two days would increase their sensitiveness; injections *secundum artem* at intervals of three or four days overcome it. As the supersensitiveness decreases, so at the same time immunity increases.[34][35]

To evoke a curative response is difficult or impossible in patients exhausted by advanced disease, and especially in those suffering from mixed infections. Tuberculin is a specific; it is useless against streptococci. It should very rarely, if ever, be exploited in mixed infections.

Patients with early closed lung disease or surgical tuberculosis, not yet attacked by pyogens, do best; they have pure tuberculosis and sufficient reserve strength to respond.

The response consists of complex, delicate and obscure biochemical processes, essentially, though not exclusively, cellular.[36] They occur in the cells of the skin at the site of the injection; in cells, especially lymphocytes,[37][38] of the body to which the blood carries such part of the antigen (tuberculin) as has not been arrested in the skin; and in and around any focus of disease. These last, the focal reaction, are similar in nature to the processes going on in the untreated tuberculous foci, and if mild, as they should be, are curative in two respects; they stimulate the production of the most powerful antibodies, such as may reduce the harmful supersensitiveness (allergy) and even convert it into the highly desirable anergy and check the action of the bacilli; also they stimulate a surrounding proliferation of fibrous tissue.[39][40][41][42]

The therapeutic response is best elicited by a cautious increase of dosage, such as 40% or less at intervals of three or four days, so that the temperature does not exceed 100° F., and that but for a few hours. When the disease is advanced, too much must not be demanded; little or no general reaction with a mild inflammatory reaction around the morbid focus is all that should be sought. Do not expect the regrowth of lung parenchyma already destroyed; healing occurs by scarring. As the fibrosis, indicative of cure, progresses, the cough and sputum diminish and a highly infectious patient often becomes harmless, and restored to a fair degree of working capacity.

Tuberculin is not an antidote to the bacilli, it is a stimulant of the natural method of cure.

Slight reactions do good; as the dose is cautiously increased the supersensitiveness diminishes, an immunity to tuberculin develops and with it an immunity, though of less degree, to other forms of tuberculin and, unhappily still less, to tuberculosis.

The mechanism of immunity is obscure and complicated, more so, indeed, than in any other infectious disease. The process of desensitization is described at length by Camac Wilkinson[43] and by Arnold Rich.[44] Rich has recently been converted to the view, so long proclaimed by Wilkinson, that immunization and desensitization go hand in hand, and that circumfocal fibrosis is a curative indication[45] The relation of allergy and immunity is treated by Topley and Wilson.[46]

To produce a high degree of immunity, large doses of tuberculin spread over a long period, perhaps a year or two, are required. When large doses, such as 0·5 millilitre or more, of undilute tuberculin are administered, the anergist will increase the interval between injections to seven or even ten or fourteen days. Even the high degree of immunity so attained will fade in time, and a second, third or fourth course may be required, except in the fortunate persons treated early whose disease may sometimes be fully arrested in a few months.

L. Bedford Elwell has recorded very good results.[47]

Though, as admitted by Maurice Davidson,[48] there are "genuine records of good effect", no claim is made that tuberculin is perfect. It is useful, but like all human products it is fallible. Linley Henzell is right in stating[49] that "if used indiscreetly it will make the patient worse"; right, too, in stating that "a few experienced and capable physicians . . . express confidence in its value".

It remains to add that old tuberculin will not produce an immunity against tuberculosis in those who have no tuberculous infection; this is reserved for such preparations as bacillary emulsion ("B.E.") and B.C.G., both of which contain tubercle bacilli, dead in the former and alive but mild in the latter. The efficiency of B.C.G. has been vaunted in France, in northern Europe and in North America, and has been, in a masterly way, demonstrated in Australia by Darcy R. W. Cowan.[50]

Finally, the suggestion has been made that over and above its specific action tuberculin has a non-specific effect. Camac Wilkinson was wont to say, more or less seriously, that it was an excellent general tonic, and some writers hold that its definite value in some cases of asthma is due not to a specific but to a "meta-specific" action.[51]

Acknowledgements.

I have to thank the Chairman of the Repatriation Commission for permission to refer to his medical officers' use of tuberculin.

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Reviews.

FUNDAMENTALS OF OTO-LARYNGOLOGY.

IN "Fundamentals of Otolaryngology", the author, Lawrence R. Boies, of the University of Minnesota Medical School, and his associates have succeeded in producing a book which is eminently suitable for the undergraduate and for the general practitioner.[1] It is not intended to be a book of reference for the specialist. It does what it purports to do—sets out simply the fundamental principles of otolaryngology as they are generally accepted today.

The book is divided into three parts; the first deals with the ear, the second with the nose, and the third with the throat. Each part is systematically set out, in chapters, describing the applied anatomy and physiology, examination, pathology and treatment. The book is well balanced, and it is pleasing to find whole chapters devoted to such things as the common cold and nasal allergy, while a few paragraphs only are devoted to uncommon conditions. The chapter "Headache and Neuralgia of Nasal Origin" includes remarks on the mechanism of headache, and such conditions as migraine, histamine headache, headaches of emotional origin, trigeminal neuralgia, and headache due to neck conditions.

The paper, print and illustrations are good. A short list of references covering recent literature, at the end of the clinical chapters, is useful. Not unnaturally, these references are mostly American, but it is rather surprising to find such a name as Cairns missing from the chapter on complications of suppurative *otitis media*.

RECENT RESEARCH IN PHARMACOLOGY.

ONE of the best and most enjoyable accounts of present-day research in pharmacology is to be found in "Recent Advances in Pharmacology" by J. M. Robson and C. A. Keele.[2] Both the authors of this book are well-known teachers of pharmacology and are closely associated with active research centres in Great Britain.

The authors, in their introduction, point out that pharmacological research has followed two main lines, fundamental investigations into the mechanisms of drug action and the search for new therapeutic agents. It is becoming increasingly clear that the former approach most frequently leads to the results of the latter, and it is this aspect which forms the principal subject matter of this book.

In eighteen chapters, the authors give a description of achievements in a variety of fields. Drug allergy and the antihistamines, muscular relaxants and anticholinesterase drugs, steroid sex hormones and the products of the adrenal cortex, bacterial chemotherapy, analgesic drugs, the newer antimalarials and many other topics make the book both stimulating and informative to the clinician and research worker alike.

Each chapter deals with the fundamental considerations of the physiological mechanisms involved, the chemistry of the drugs employed, their mode of action and general properties, and concludes with an evaluation of the new agents in therapeutics. Each chapter, too, contains the principal references to the literature, and these are collected together at the conclusion of that chapter—probably the most satisfactory arrangement which can be made.

The authors are to be congratulated on making a real effort to present uniformity on the difficult question of drug nomenclature and they use wherever possible either the official names or those approved by the General Medical Council. These are, in fact, the names by which the drugs should be labelled by the manufacturer whether or not an associated proprietary name is added, and most certainly they are the only names acceptable in a publication of this kind.

It is indeed difficult in such an excellent book to comment on any particular aspect, but the inclusion of a chapter on the "Evaluation of the Actions of Drugs in Man" is a valuable contribution to the vexing problems of clinical trial design. An outline of simple statistical methods forms part of this chapter and the clarity of this section will make it attractive to the least mathematically inclined reader. Another absorbing chapter is devoted to methods for investigating the fate of drugs in the body, a subject usually to be studied only by an intensive search of the literature.

This book can be strongly recommended to all students of pharmacology, especially those who may have thought the subject dull and encyclopædic; the busy physician, too, will find it enjoyable for moments of relaxation.

ANXIETY IN PREGNANCY AND CHILDBIRTH.

IN their monograph "Anxiety in Pregnancy and Childbirth" the authors, Henriette Klein, Harold Potter and Ruth Dyk, have made a noteworthy addition to the pages of psychosomatic medicine.[1]

The confidential story concerning the somatic and emotional changes is told in the cases of twenty-seven *primiparæ* and the resulting data have been analysed and tabulated. These case histories should be thoroughly studied, and this presents no difficulties as they are written in pleasing style and the story plan is uniform in all cases.

To the psychiatrist and social workers the attitudes and reactions towards conception and pregnancy described in Chapter II are full of interest and the reader's attention is drawn to the very pertinent question of housing, living with in-laws and "can we supply space for a baby" *et cetera*.

In Chapter IV, which deals with psychosomatic relationships, we find the statement "the physiologic progression of labour and delivery and the psychologic reaction to labor and delivery are obviously interdependent".

The authors refer to the importance of basic personality organization and to the attitude to conception and pregnancy with its course. Their psychiatry keeps to the safe and tried paths and will meet with approval from all interested in this subject.

Taken as a whole the material dealt with in the monograph is stimulating in its presentation and cannot fail to be of help to most members of the medical profession who have any dealings with the all-important subject indicated in the title page.

FACIAL PARALYSIS.

"FACIAL PARALYSIS: BEING A TREATISE ON A CLINICAL CLASSIFICATION OF PARALYSIS OF THE FACIAL NERVE", by J. Parkes Findlay, is a comprehensive little volume which shows evidence of a good deal of research and thought on the subject.[2] Since Sir Charles Bell, in 1821, described the findings in lower motor neuron paralysis of the seventh cranial nerve, all cases of paresis of that nerve have been labelled Bell's palsy regardless of ætiology. This treatise

[1] "Fundamentals of Otolaryngology: A Textbook of Ear, Nose and Throat Diseases", by Lawrence R. Boies, M.D.; 1949. Philadelphia and London: W. B. Saunders Company. Melbourne: W. Ramsay (Surgical) Proprietary, Limited. 9″ × 6″, pp. 468. Price: 61s. 9d.

[2] "Recent Advances in Pharmacology", by J. M. Robson, M.D., D.Sc., F.R.S.E., and C. A. Keele, M.D., F.R.C.P.; 1950. London: J. and A. Churchill, Limited. 8″ × 5½″, pp. 430, with 46 illustrations. Price: 24s.

[1] "Anxiety in Pregnancy and Childbirth", by Henriette R. Klein, M.D., Howard W. Potter, M.D., and Ruth B. Dyk, M.S.; 1950. New York: Paul B. Hoeber, Incorporated. 9¼″ × 6″, pp. 124. Price: $2.75.

[2] "Facial Paralysis: Being a Treatise on a Clinical Classification of Paralysis of the Facial Nerve", by J. Parkes Findlay, M.B., Ch.M.; 1950. Published by the author and distributed by Angus and Robertson, Limited. 9½″ × 6″, pp. 48, with a few illustrations.

represents an attempt (*a*) to determine the ætiological factors from the clinical signs and symptoms; (*b*) to perfect the technique for the decompression operation; (*c*) to note anatomical variations and pathological changes; (*d*) to assess the value of decompression; (*e*) to ascertain the most appropriate time for operation.

The anatomy of the peripheral portion of the nerve and branches, both motor and sensory, is fully described, together with two variations from the normal in the course of the Fallopian canal which have been observed by the author.

This is followed by a section on examination, including electrical tests, one on symptomatology, and another one on diagnosis of the clinical entity. Four of these entities are described, namely, geniculate, neuritic, vascular occlusion and traumatic facial paralysis.

Treatment of each type is dealt with, and for vascular occlusion facial paralysis the operation for decompression of the Fallopian canal and incision of the sheath of the facial nerve is described. Using a posterior auricular incision, the author has evolved a technique combining the posterior auricular approach with that of the end-aural and attico-antrotomy route. In the later stages of the operation he uses operating glasses of "3x" magnification, and finally a dissecting microscope.

A short section on prognosis concludes a useful and informative booklet which can be recommended to the otologist.

There are several illustrations and a bibliography.

A "PARKINSONIAN" ON HIS MALADY.

"THE toad beneath the harrow knows exactly where each tooth-point goes": the proverb is illustrated by Mr. Walter Buchler, a breezy, observant layman of ripe years, in a booklet on "Parkinson's Disease".[1] Mr. Buchler is a sufferer from this malady and writes for others similarly afflicted. The booklet is like a foreign language phrase book; but instead of phrases there are homely hints and wrinkles. It is a Parkinsonian vade-mecum for all conceivable occasions and forms of activity and self-expression: dress, table tactics, travelling, arranging the house, planning the day's work, reading, hobbies, domestic economics and many others. Digressions abound: amongst them are some amusing, if irrelevant, observations on the deductions that can be made about the doctor and his background from the magazines, furniture and pictures in his waiting room.

BRUCELLA INFECTION.

"BRUCELLOSIS (UNDULANT FEVER), CLINICAL AND SUBCLINICAL", is the title of a monograph by Harold J. Harris, which now appears in its second edition.[2] The author, originally a country doctor, was stimulated to study Brucella infection by a growing conviction that he had often failed to recognize it during his early years of practice. The first edition of his book, published in 1941, was largely a clinical study, based on close observation of 250 patients with the disease. In its new form, this book has been revised and enlarged to include observations made on 450 additional patients, and fuller discussions of laboratory diagnosis and of modern treatment. The word "brucellosis" is a cumbersome one and its appropriateness may be questioned. Undulant fever has been known, under many different names, for 2500 years; it is protean in its manifestations and it still presents many unsolved problems. The long, still unfinished story is a fascinating one; Harris appreciates it fully and his book is the work of an enthusiast. Since the time of Hippocrates a low type of fever, characterized by fairly regular remissions, has been known along the shores of the Mediterranean. It has been called Malta fever, Mediterranean fever, Neapolitan fever, country fever of Constantinople, new fever of Crete, rock fever of Gibraltar and so on. In 1887 David Bruce reported the discovery of a small microorganism, which he called *Micrococcus melitensis*, in the spleen of patients dying of Malta fever. In 1897 Bang announced the isolation of a small bacillary organism which he believed to be the cause of contagious abortion in cattle; he named it *Bacillus abortus*. In 1914 Traum isolated a similar organism from the fœtus of a sow; it was called *Bacillus suis* and was recognized as the cause of swine abortion. After the discovery of these organisms a period of great confusion in terminology occurred. It was found that all three organisms gave rise to very much the same symptoms in man and that infections due to them were widespread all over the globe. The old geographical names were therefore no longer appropriate and Hughes, whose classical monograph was published in 1897, suggested the name undulant fever because of its intermittent course. This name in turn became inadequate, for it was found that non-febrile infections could occur. In 1920 the generic name Brucella was suggested for the organisms of this group by Meyer and Shaw, in honour of David Bruce; this met with universal approval. Alice Evans pointed out that "the name brucellosis is preferable to all others because it simply expresses infection with Brucella, regardless of the nature of the disease response, and because it is applicable to the disease in man or in any of the lower animals". Topley and Wilson, in their well-known text-book, deprecate the use of this term, however, pointing out that the arguments for it apply almost equally to diseases caused by all other infective agents. They prefer to speak of Brucella infection, and this term is in fact more precise as well as more euphonious. It has often been said that infection with Brucella resembles in many respects infection with the tubercle bacillus; in the majority of persons infections with either tend to remain latent or to retrogress. Harris observes that a more or less definite type of infectious granuloma, sometimes with giant cells, has been described in Brucella infections; this tissue reaction is similar to that of tubercle bacillus infection, but the subsequent history of the Brucella lesion is usually very different from that of the tuberculous one.

Harris's monograph is a large book, with 111 excellent illustrations, many of which show lesions occurring in patients observed by him. The reproduction of radiographs and photomicrographs is particularly fine, as indeed is the type and general production of the book. In a chapter entitled "Epidemiology" Harris records the number of cases of brucellosis reported in various countries in the years 1936 to 1947 inclusive; in each year a small number of human infections were reported from Australia and from New Zealand. It is, of course, well known that Brucella infection occurs in cattle and swine in both countries. The book concludes with an admirable and very thorough-going chapter on prophylaxis; the author believes that Brucella infection, like typhoid fever, should not be allowed to occur among civilized people. On the whole this is an interesting and important book, but it could have been pruned. A certain amount of repetition is, of course, unavoidable in a systematic study as the subjects of different chapters overlap to a certain extent. But the style is often cumbrous and involved; some sections could have been written as well, indeed far better, in half the words and in neater, shorter words. More discrimination might have been shown in the selection and collation of material. However, the author's enthusiasm is infectious and his book cannot fail to arouse a lively interest in Brucella infection among all intelligent readers.

PROTOZOOLOGY.

SEVERAL text-books of general parasitology contain excellent accounts of the protozoa parasitic in man, but it is many years since a book has been written exclusively about these organisms. Dr. Cecil Hoare has attempted to fill the gap, or at least that part of it which is felt by the teacher in an undergraduate or post-graduate school.[1] While he hopes also for a wider audience, he has kept his main purpose clearly in mind, and has deliberately restricted himself to a "frankly didactic", impersonal presentation of essentials, with no historical background, a minimum of discussion, and no references in the text. Within these limits, the presentation is clear and well balanced, and the illustrations are in keeping, being sufficiently diagrammatic to emphasize the essential characters of the organisms and their life histories. The format and printing are excellent, and typographical errors are few, though a "$\frac{1}{2}$ in." oil-immersion objective on page 273 was momentarily startling.

[1] "Parkinson's Disease", by Walter Buchler; 1950. London: Walter Buchler. 7" x 5", pp. 80. Price: 5s. 6d. (paper cover) and 8s. 6d. (cloth cover).

[2] "Brucellosis (Undulant Fever), Clinical and Subclinical", by Harold J. Harris, M.D., F.A.C.P., with the assistance of Blanche L. Stevenson, R.N., and a foreword by Walter M. Simpson, M.S., M.D., F.A.C.P.; Second Edition, revised and enlarged; 1950. New York: Paul B. Hoeber, Incorporated. 9¼" x 6¼", pp. 642, with 44 illustrations. Price: $10.00.

[1] "Handbook of Medical Protozoology: For Medical Men, Parasitologists and Zoologists", by Cecil A. Hoare, D.Sc. (London); 1949. London: Baillière, Tindall and Cox. 9" x 6½", pp. 356, with 43 illustrations. Price: 35s.

The book is divided into three parts. The first (64 pages) is a general account of the protozoa, their structure, physiology, reproduction and behaviour. The emphasis falls naturally on the parasitic forms, and the chapter on their ecology is probably the best in the book; at least, it offers more inducement to meditation than any other. The second part (207 pages) deals systematically with the parasites that occur in man, presenting them conveniently in the two main ecological divisions of those that live in the alimentary and genital tracts and those that live in the blood and tissues. It is clear, succinct, and generally adequate. A short section on coprozoic protozoa is a useful inclusion, which is, perhaps, offset to some extent by a very cursory treatment of *Toxoplasma*. The differences in behaviour of malaria parasites in different parts of the world might also have received more attention, for they are of considerable practical and biological interest. A rather irritating feature of this part is repetition of basic statements, doubtless a result of the didactic style, but giving the impression that the subsections were written separately and assembled afterwards. The third part (45 pages) contains brief descriptions of the technical procedures which the author has found to be reliable. There is, finally, a short list of references, mostly well-known text-books.

The student who reads this book will be well prepared for examinations and for practical work in the field; but the worker who is really interested in the protozoa will be disappointed, and perhaps a little repelled by the stark impersonality of the writing. Dr. Hoare has had such a long and wide experience that we hoped for something new and individual, but a successor to our worn and cherished "Wenyon" has not yet been found.

SYMPTOMATOLOGY IN CLINICAL MEDICINE.

In the first volume of "Major Symptoms in Clinical Medicine" John Almeyda has covered a wide field of general medicine.[1] The term "symptom" is taken to cover the presenting or dominant feature of a case, and therefore sections on hypoproteinæmia and hypoglycæmia appear along with sections on such clinical entities as anomalies of pigmentation, cough, hæmoptysis, cyanosis, pallor and purpura.

In a brief introduction the reader is reminded of the principles of case taking. The five sections of the book cover objective symptoms, and symptoms usually referable to respiratory, cardio-vascular, alimentary and renal systems. When symptoms such as hæmoptysis may be produced by disease of more than one system the subject is fully dealt with in one section and a suitable cross reference is included in the other. The work is profusely illustrated with line drawings, photographs and coloured plates. Some of these are excellent, others are of minor value only and help but little in the exposition. The line drawings of the tongue in different diseases fall into this category.

Each section includes a discussion of anatomical and physiological aspects. The various symptoms are then discussed. In most cases a classified list of causes is given, followed by a brief discussion with suggestions for further investigation.

Ryle's statement, "Eyes without the microscope, ears without the stethoscope, wits without the help of chemical, radiological or instrumental methods can carry us a long way", is quoted at the outset of the book. Presumably it was the intention of the author to write a treatise with this as text. The final product, however, resembles more the notebook of a candidate for the M.R.C.P. diploma. Some students will probably gain much from careful study of its pages. There is a wealth of information tabulated and arranged for ready reference. The teacher of clinical medicine may find assistance in many sections of the book. Senior undergraduates will find that the information covers a wide ground, but obviously is not a complete exposition of the subject, and that the volume is therefore more useful as a work of reference than as a text-book. General practitioners will find it useful as an index of differential diagnosis.

There are some statements with which it is difficult to agree. For example, in regard to loss of weight in children it is difficult to accept the statement that "in cases of cardiac diseases electrocardiograph changes will establish a diagnosis".

There are some rather obvious typographical errors; for example, pre-natal for pre-renal suppression of urine, intra-pyramidal for extra-pyramidal in regard to Parkinson's disease; but generally the book is well printed on excellent paper, well indexed and conveniently arranged for ready reference. To those who are helped by tabulated and systematized presentations of medical information this book should appeal.

A TALE OF STRUGGLE AGAINST DISEASE.

"MY PLACE TO STAND", by Bentz Plagemann, is the personal story of a victim of infantile paralysis, a record of the struggle against great odds and of final victory.[1] After two years of treatment the author was finally able to leave his wheel-chair and to walk with the aid of crutches. In the foreword he asks two questions: "Can a state of mind create the conditions for a predictable state of illness in the body?" and "Does the inherited or environmental nature of our being make us prone to an equal area of ills?" The author elaborates on these.

The story opens in 1944 when the writer was in the United States Navy as pharmacist's mate on a vessel voyaging to Africa. He tells a graphic story of his duties, which were many and varied, combining those of doctor and chaplain, as well as many others. He was taken ill on board and was landed at Naples, and in hospital there was so ill that he was given the last sacrament. However, he rallied and was later shipped back to the United States. The rest of the story tells of his mental, physical and spiritual endeavours to get well, of how he did all that was possible to aid the ministrations of physicians and nurses, and how he finally won through. The psychological analysis of life as expounded in the later chapters supplies an interesting picture of heroic living to conquer physical disability. As well as being interesting reading for doctors, this book will help similar sufferers to overcome their handicaps.

OCCUPATIONAL OPHTHALMOLOGY.

"OCCUPATIONAL EYE DISEASES AND INJURIES", by Joseph Minton, is an excellent little book within its scope which is apparently to give to the industrial medical officer and to nurses a general review of the subject.[2] It is well set up and printed and with good illustrations gives a comprehensive picture of the subject generally. As a reference book for the industrial ophthalmologist it would be of limited value. Occupational ophthalmology has developed into what we may call ophthalmology *plus*, and one can recall few eye diseases that have not been tested and very few that have not been accepted as having been either influenced by industry or due to accident associated with employment.

The work is sketchy in regard to treatment and the handling of patients generally and no practical help (and this is badly needed) is offered to the physician in the writing of reports and in the assessment of losses. This is a very particular and extremely complex problem in this branch of medicine. Serious objection can be taken to some suggestions.

In relation to the handling of simple corneal foreign bodies which economically are most important as causing by far the greatest time loss in occupational eye accidents, no more incompetent instrument than a Bowman's needle for the removal of foreign bodies could be suggested—it is mechanically unsuited to the work it is expected to do.

The use of the 24-hour pad and bandage and instructions to the patient to report again the day following removal are surely gospels of despair. They both set up an ocular

[1] "Major Symptoms in Clinical Medicine", by John Almeyda, M.R.C.P., D.P.H. (London), M.R.C.S. (England), with a foreword by Sir Adolphe Abrahams, O.B.E., M.A., M.D. (Cambridge), F.R.C.P. (London); 1950. London: Henry Kimpton. 9½" × 6½", pp. 392, with 185 illustrations. Price: 25s.

[1] "My Place to Stand", by Bentz Plagemann; 1950. London: Victor Gollancz, Limited. 8½" × 5½", pp. 250. Price: 10s. 6d.

[2] "Occupational Eye Diseases and Injuries", by Joseph Minton, F.R.C.S. (England); 1949. London: William Heinemann (Medical Books), Limited. 8½" × 5½", pp. 196, with 24 illustrations. Price: 21s.

incubator for the development of infective organisms and waste man-hours.

Finally the non-removal of all the rust (and char) at the first sitting is to be deplored. It can in at least 99% of cases be fully removed, and when this is done and adequate treatment given and ordered the patient should resume work immediately and be told to report again if the position warrants it. The number that do so is negligible.

OBSTETRICS AND GYNÆCOLOGY.

A BOOK most useful to all students and doctors doing post-graduate studies is "A Synopsis of Obstetrics and Gynæcology" by Aleck W. Bourne, the tenth edition of which has recently been produced.[1] Based as it is upon the author's wide personal experience, the book has an essentially practical outlook towards the teaching of the subjects, and while, as stated in the preface, "no book, least of all a synoptic book, can replace attendance at clinics and the study of the ordinary textbook", yet for revision and refresher purposes such a book is invaluable. The tabular manner in which a lot of the topics discussed are set out enables them to be quickly revised and memorized without the student having to sift out the salient features as is the case in many text-books.

In the section devoted to obstetrics, all phases of the subject are adequately covered and clear and concise instructions are given for dealing with both the normal and the abnormal events associated with pregnancy, and many of the procedures are illustrated by a series of sketches. These, although small, are nevertheless very clear. Both the surgical and medical aspects of treatment as related to gynæcological conditions are discussed fully, but as would be expected in such a book, operative techniques are not included. The indications for chemotherapy and its scope and limitations in treating various infectious processes are discussed, and so, too, are radium and deep X-ray therapy. This book can be recommended confidently to all students of the subject.

HYSTERIA.

"THE DIAGNOSIS OF HYSTERIA", by D. W. Abse, is based on the clinical experience and study of several hundred cases of hysteria.[2] The patients were seen while the author served as a military psychiatrist in the United Kingdom and India from 1942 to 1946.

The main purpose of the book is to indicate how a diagnosis of hysteria can be made positively and readily rather than by the usual practice of exclusion after the physical examination and a number of laboratory tests have given negative results.

Emphasis is placed on the pattern of symptoms, but in the diagnosis of hysteria there is also the need to find some emotional conflict or causative problem. This is an essential part of the diagnosis.

This monograph generally serves its purpose in showing the differences between hysteria and physical disease. However, it fails to differentiate hysteria adequately from other psychological disorders as the anxiety reaction. It is equally important to differentiate these different psychological conditions as the different types of physical disease.

The reader is left in some doubt whether hysteria can be due to simple environmental problems or whether, in all cases, it reflects some deep-seated cause. There is little information on how far childhood attitudes should be explored in the making of a diagnosis. The use of "Pentothal" in the diagnosis in acute cases is scarcely discussed.

With these exceptions the book describes many of the common hysterical symptoms and the type of problem that is responsible for their production.

[1] "A Synopsis of Obstetrics and Gynæcology", by Aleck W. Bourne, M.A., M.B., B.Ch. (Cambridge), F.R.C.S. (England), F.R.C.O.G.; Tenth Edition; 1949. Bristol: John Wright and Sons, Limited. London: Simpkin Marshall, Limited. 7¼" × 4¾", pp. 536, with 167 illustrations. Price: 21s.

[2] "The Diagnosis of Hysteria", by D. W. Abse, M.D., B.Sc., D.P.M., with a foreword by John H. Ewen, F.R.C.P. (Edinburgh), D.P.M.; 1950. Bristol: John Wright and Sons, Limited. London: Simpkin Marshall, Limited. 7¼" × 5", pp. 112, with seven illustrations. Price: 8s. 6d.

Books Received.

[The mention of a book in this column does not imply that no review will appear in a subsequent issue.]

"Blood Groups in Man", by R. R. Race, Ph.D. (Cantab.), M.R.C.S. (England), and Ruth Sanger, Ph.D. (London), B.Sc. (Sydney), with a foreword by Professor R. A. Fisher, F.R.S.; 1950. Oxford: Blackwell Scientific Publications, Limited. 8½" × 5½", pp. 312, with illustrations. Price: 30s.

Deals with blood groups and their inheritance.

"Plastic and Reconstructive Surgery: A Manual of Management", by F. Smith, M.D., F.A.C.S.; 1950. Philadelphia and London: W. B. Saunders Company. Melbourne: W. Ramsay (Surgical) Proprietary, Limited. 9¼" × 6", pp. 924, with many illustrations. Price: £7 2s. 6d.

The author's object is to give a true perspective of plastic surgery and its procedures.

"Proctology in General Practice", by J. Peerman Nesselrod, B.S., M.S., M.Sc. (Med.), M.D., F.A.C.S., F.A.P.S.; 1950. Philadelphia and London: W. B. Saunders Company. Melbourne: W. Ramsay (Surgical) Proprietary, Limited. 9¼" × 6", pp. 300, with many illustrations. Price: 57s.

Intended for medical students, house officers and general practitioners.

"Medical Diagnosis: Applied Physical Diagnosis", edited by R. L. Pullen, M.D., F.A.C.P.; Second Edition; 1950. Philadelphia and London: W. B. Saunders Company. Melbourne: W. Ramsay (Surgical) Proprietary, Limited. 9¾" × 6¼", pp. 1138, with many illustrations, some of them in colour. Price: £5 18s. 9d.

There is an attempt "to portray the methods of diagnosis and their interpretation applicable to each individual system or region of the body".

"Reports on Biological Standards: VI. 'The Design of Toxicity Tests'", by W. L. M. Perry; 1950. Medical Research Council Special Report Series 270. London: His Majesty's Stationery Office. 9½" × 6", pp. 58, with illustrations. Price: 1s. 6d.

The aim of the report is to review information on the design of toxicity tests of pharmacological substances and to assess the relative merits of each design.

"The Control of Tuberculosis in a British Colony", by V. Hetreed, M.B., B.S. (Lond.); 1950. London: National Association for the Prevention of Tuberculosis. 7¼" × 5¼", pp. 50. Price: 7s. 6d.

A prize essay on modern methods for controlling tuberculosis in a British colony.

"The Medical Clinics of North America" (issued every two months); 1950. Philadelphia and London: W. B. Saunders Company. Melbourne: W. Ramsay (Surgical) Proprietary, Limited. Mayo Clinic Number. 9" × 5½", pp. 322, with many illustrations. Price: £7 5s. *per annum* (cloth binding) and £6 *per annum* (paper binding).

Contains a symposium by 18 contributors on psychiatry and the general practitioner, eight papers on various aspects of amyloidosis, and five individual papers on diseases of the cardio-vascular and hæmatopoietic systems.

"Atlas of Human Anatomy: Descriptive and Regional", by M. W. Woerdeman, M.D., F.R.N.A.Sc.; Volume II, Splanchnology—Angeiology—Nervous System—Organs of Sense. London and Australia: Butterworth and Company (Publishers), Limited. Amsterdam: Wetenschappelijke Uitgeverij N.V. 10" × 6¼", pp. 704, with 642 illustrations.

Consists entirely of illustrations with no letterpress.

"Hay-Fever: A Key to the Allergic Disorders", by J. Freeman, D.M. (Oxon); 1950. London: William Heinemann (Medical Books), Limited. 9¼" × 7¼", pp. 348, with illustrations. Price: 42s.

The author worked with Almroth Wright and deals with laboratory and clinical methods.

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All articles submitted for publication in this journal should be typed with double or treble spacing. Carbon copies should not be sent. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

References to articles and books should be carefully checked. In a reference the following information should be given without abbreviation: surname of author, initials of author, year, full title of article, name of journal without abbreviation, volume, number of first page of the article. If a reference is made to an abstract of a paper, the name of the original journal, together with that of the journal in which the abstract has appeared, should be given with full date in each instance.

Authors who are not accustomed to preparing drawings or photographic prints for reproduction are invited to seek the advice of the Editor.

THE BIOLOGICAL APPROACH.

THE biological sciences, including the medical, claim without apology, defence or explanation to be as fit to be enrolled amongst the true sciences as physics and chemistry. They display the same systematized knowledge, there is the same appeal to consistency in experiment, when experiment is possible or permissible, and failing this, to the concordant results of accurate observation. In each we find the application of Occam's razor—"things not known to exist should not, unless it is absolutely necessary, be postulated as existing"—and so in each the supernatural is not invoked. Physics and chemistry supply two fundamental concepts to biology: the first is that the constituents of living matter are the same as those in the inanimate world, the second is that the law of the conservation of energy is adhered to in the living with the same rigorous exactitude as in the non-living. That biology will draw more and more upon the basic natural sciences and especially upon the borderland between them is easily predicted because easily demonstrated day by day. In recent times the application of quantum mechanics to certain biological processes such as photosynthesis has been exceptionally fruitful and promising. Still, if we make every allowance for suggestive similarities and for frequent borrowing, there are outstanding differences between the study of the living and of the non-living and so the biological approach must of necessity vary widely from the attitude of the physicist and chemist.

Max Delbrück, of the California Institute of Technology, a distinguished physicist, has given a thoughtful comparison between the two in an address entitled "A Physicist Looks at Biology". The physical sciences present us with a brilliant series of unifications, that is, describing natural phenomena with a reduction in the number of unknowns; terrestrial and celestial mechanics were reduced to one science by Newton, chemistry and electricity were given a common basis by Faraday, optics and electromagnetics were brought together by Maxwell, chemistry and atomic physics were unified by the doctrine of quantum mechanics. In biology we have no such dazzling achievements, except perhaps in the principle of evolution which has not been established by decisive experiments, but has become more and more inescapable as knowledge of living things increases. The dominance of the past is rightly insisted on by Delbrück: "Every biological phenomenon is essentially an historical one, one unique situation in the infinite total complex of life." And again: "Any living cell carries with it the experience of a billion years of experimentation by its ancestors." Such dependence on past occurrences is rare and mostly unimportant in the non-living. It is true that each melting of a gel conditions a lowering of temperature of succeeding liquefactions, but this is regarded as one of the anomalies of colloidal chemistry. That radio-active elements have slipped down the energy incline in the past and produced stable end-products has been used in the approximate determination of the age of the earth's crust; the same principle is employed with more admixture of conjecture in solar and stellar physics. Delbrück would have been on surer ground had he mentioned that preparation for the future is inherent in living matter, whereas in the non-living considerations of what may eventually happen are totally absent. The most primitive animal stores food particles and in its reproductive phases shows unmistakable provision for needs likely to arise at a later date. The higher the living creature is in the evolutionary scale, the greater is its preparation for the future. Again, structure plays a part in living tissue which is far less prominent in the purely physical, or perhaps it might be better expressed by stating that the biologist has been more consistently aware of the importance of structure than the physicist and chemist. Again and again have suggestions been made by those untrained in biology to explain living processes which indicate complete ignorance of the role which structure plays in the lower as well as in the highest forms of life. The enormously complex organization of the simplest cell with, for example, enzymes situated in proper strategic positions, is something which the physicist by his training is little likely to comprehend. Considerations of teleology or purpose are repugnant to the physicist and chemist, but the biologist, however deftly he may explain these away by natural selection, keeps them constantly in mind. As a typical example of the difference in outlook let us take the fact that white flowers generally pour out their perfume most vigorously at night. The physicist Tyndall was quite satisfied with his discovery that the volatile matter emitted by these flowers has a lower conductivity of heat than ordinary air and so the flower is shielded from the effects of a too pronounced fall of temperature. The biologist with a smile seeks the explanation in the fact that the enhanced odours attract nocturnal moths and so facilitate pollinization. When traffic guides were painted on roads with a yellow pigment several physicists protested that white reflects more light energy than yellow; they were perfectly right, but they did not know that from the standpoint of the physiology of the eye, yellow is the preferable colour. Whilst pitfalls beset the student

[1] "A Physicist Looks at Biology", by Max Delbrück, *Transactions of the Connecticut Academy of Arts and Sciences*, Sesquicentennial Celebration, Proceedings Part II, Volume XXXVIII, December, 1949, page 177.

of non-living matter when he essays to enter the biological domain—and a striking instance of this can be found in the work of a distinguished English chemist in plant photosynthesis—the converse of this is equally true, namely, that biologists sometimes endeavour to apply mathematical analysis to living processes where numerical assessment is faulty or impossible. As Delbrück remarks: "Actually most branches of biology manage to flourish without any recourse to this ideal. All of natural history operates with a system of concepts which has very little contact with the physical and chemical sciences. The habits of animals and plants, their reproduction and development, their relations to their symbionts and to their enemies, can all be described and analysed with very little reference to the concepts of physics and chemistry."

We all admit the force of Kelvin's aphorism that until facts can be expressed numerically they are not properly understood. Every encouragement should be given to those who seek precision in bodily happenings and assemble data which lend themselves to statistical or ordinary mathematical treatment, but a warning is necessary about the adoption of numerical estimates where actually a large margin of error exists. Education enthusiasts recording the intellectual capacity of pupils in scalar form and possibly determining therefrom the careers of their charges, researchers in psychology using slide-rules in tabulating aberrancies of human conduct, are examples all too common today of a departure from rigorous scientific method. Napoleon made Laplace, the eminent mathematician, his Minister of the Interior, but had to dismiss him, for, in the words of the great captain, "he applied the infinitesimal calculus to human actions". This danger is particularly pressing in the realm of medicine. The family doctor who knows his patient's heredity, up-bringing and environment possesses an enormous initial advantage over the diagnostician who is guided by the graphically recorded findings of separate experts. Even when an organ has a purely physical task to perform it is a mistake to discard psychical influences. The heart is a pump, but it is a pump under emotional regulation. To regard the eye as a physical instrument is almost certain to invite diagnostic and therapeutic disaster. We conclude therefore that whilst the biologist, including the medical practitioner, should be responsive to every suggestion emanating from the physicist and chemist, he should never lose the biological approach.

Current Comment.

ETHYL ALCOHOL AS A GERMICIDE.

ETHYL ALCOHOL is in wide and constant use as a disinfectant, but its precise value in this role is the subject of recurring controversy. In various forms it has been applied empirically to wounds for a very long time, and for over half a century its germicidal effect in concentrations less than that of absolute alcohol has been recognized, as well as the fact that it has little or no action on spores. However, its practical value is still the subject of a good deal of misunderstanding in the direction of both underestimation and overestimation. In a recently published paper Philip B. Price,[1] who has written a good deal on this particular subject, makes a new effort to settle finally this old but still controversial question. It is, as he points out, a matter of practical importance, because alcohol is universally employed as a skin disinfectant and as a solvent for other germicidal agents, and not infrequently also as the solution of choice for cold sterilization of instruments including sharp instruments. He has repeated his previous work on a larger scale, testing various dilutions of alcohol *in vitro* as well as on the arms and hands of several subjects, with the particular object of finding out the strength of alcohol which is best for disinfectant purposes. In-vitro studies have shown that some concentrations of alcohol are ineffective, but that others are strongly and rapidly germicidal. In general 10% and 20% solutions by weight have little or no bactericidal effect in ten minutes or less at room temperature. Solutions of 30%, 40% and 50% strength have progressively greater germicidal power, and 60% to 90% solutions by weight are all strongly and rapidly bactericidal; much of the killing effect apparently takes place during the first few seconds of contact. Absolute alcohol is much less strongly bactericidal than the 70% to 80% strengths, but it cannot be classed as wholly ineffective. *Staphylococcus albus* obtained from the resident flora of the skin was observed to be more resistant to ethyl alcohol than either *Staphylococcus aureus* or *Escherichia coli* taken from stock laboratory cultures. Spores of various sorts were found to be highly resistant to all concentrations of alcohol at room temperature, although vegetative forms of the same organisms were killed. Various concentrations of alcohol were also tested under conditions of actual use on the hands and arms. Solutions of 60% strength by weight and stronger were all shown to be efficient skin disinfectants. The optimum concentration varied with different persons, and even in the same person from time to time, probably because of variations in the flora and condition of the skin. Price concurs with the widely held view that 70% alcohol by weight is still the solution of choice for disinfection of the skin. He states that in addition to being powerfully germicidal, this solution spreads well, dries slowly, does not extract cutaneous fats, is almost perfectly innocuous on healthy skin, and is proportionately less expensive than higher concentrations. He recommends that the operator, when preparing for surgical procedures, should after a thorough scrub dry his hands and arms with a sterile towel; then he should wash in two solutions of alcohol with wash-cloth friction, first briefly in a basin containing a solution of 95% by volume (commercial) alcohol, and then for two or three minutes in a basin containing a solution of 70% alcohol by weight. If the skin is healthy, this simple routine, it is claimed, will scarcely fail to reduce its bacterial count greatly (to approximately 1% or 2% of the original number), whatever the initial size or specific composition of the flora. The main reason given for recommending the wash in 95% alcohol solution is to remove all remaining traces of water from the skin, and thus to avoid dilution and weakening of the potent 70% solution. An incidental advantage is that this step adds to the total germicidal effect, especially in persons such as one whom Price tested, whose cutaneous bacteria happened to be more susceptible to the higher concentrations of alcohol. Price's strictures on the use of ethyl alcohol as a disinfectant in wounds or on raw surfaces should need little emphasis. There must be very few who today use it in this role. It is sufficient to repeat that it is painful, it injures the tissues, and its antibacterial action is neutralized by proteins present in the wound. The last point, the use of ethyl alcohol solutions for the cold sterilization of instruments, is more controversial; but it cannot be advocated as a satisfactory agent, despite those who defend its use on the grounds of their personal experience. Perhaps its most important shortcoming is its inability to kill spores, and it is well to note in passing a statement in "Topley and Wilson" that commercial alcohol as a rule contains spores. Even vegetative bacteria may escape destruction if they are hidden in the joint of scissors or are protected by residual grease or blood clot, or if they lie in some inaccessible part of a complex instrument to which the alcohol does not permeate. Alcohol or any other cold solution for that matter should

[1] *Archives of Surgery*, March, 1950.

not, as Price rightly states, be expected to sterilize the lumen of a needle dropped into it. A momentary dipping of an instrument into alcohol is a futile gesture; yet prolonged soaking tends to rust metal. It must be admitted that the ideal germicidal solution for cold sterilization of instruments is hard to find, and that some of the more useful preparations in current use contain alcohol as an ingredient. But the defects of alcohol for this purpose are glaring. On the other hand, it is a convenient type of solution and is bound to retain its popularity for various disinfectant uses. Price's paper, while bringing forward little that is new, is of value in clarifying issues that are still more confused than they have a right to be.

LOSS OF VISION AFTER DISTANT HÆMORRHAGE.

THE loss of vision which occasionally follows hæmorrhage in a part of the body remote from the eye is an intriguing but rather terrifying phenomenon. It is rare, but is nevertheless well known, presumably because of its bizarre character. The first mention of the condition, according to R. W. Hollenhorst and H. P. Wagener,[1] was made by Hippocrates, and records have been found of altogether some 300 cases. It is still something of a mystery, although a good many theories of its nature and cause have been put forward. Hollenhorst and Wagener, who report the comparatively large series of five cases, discuss the various theories that have been offered, review the literature and give a general description of the condition. Its clinical course is variable. The onset of the visual loss is usually instantaneous, but it may come on gradually over the course of several hours, and rarely it may progress for several days. If the initial loss of vision has not been complete, subsequent hæmorrhage may cause further blindness. The loss of vision varies considerably in degree and type; it may be unilateral or bilateral, and may range from complete blindness in both eyes or blindness in one eye and only slight loss in the other, to only very mild loss of vision in one eye. There may be other effects, some of them probably resulting from cerebral ischæmia, and there may be signs suggestive of cerebral thrombosis. The defects in the fields of vision, when it is possible to plot them, vary greatly in type. The most common feature found on examination of the ocular fundi seems to be ischæmic optic neuritis. Sometimes the ophthalmoscopic appearance is that of closure of the central retinal artery or of one of its branches. In all reported cases in which changes could be seen ophthalmoscopically in the early stages, optic atrophy developed subsequently. Most patients who were examined several months after the loss of blood had occurred had well-developed optic atrophy and attenuated arterioles. The prognosis is difficult to assess. According to most authors the vision lost is seldom regained completely, but the degree of recovery in different cases varies. There is evidence to suggest that the prognosis for recovery varies notably with the lapse of time between the hæmorrhage and the onset of blindness. One investigator has stated that the prognosis is least favourable in cases in which the hæmorrhage is from the stomach. The condition is slightly commoner amongst women, presumably because of the greater incidence of hæmorrhage as a consequence of menstruation, childbirth and abortion. Loss of vision from hæmatemesis, however, occurs predominantly among men. An appreciable number of cases from the earlier records resulted from blood-letting. Other less important causes recorded are epistaxis, wounds, hæmoptysis and urethral bleeding. Traumatic hæmorrhage, no matter how severe, rarely produces loss of vision of this character, but the reason for this has never been adequately explained. Furthermore, loss of vision only rarely follows an initial hæmorrhage, but usually comes after repeated episodes of bleeding. It has been said that blindness due to loss of blood never occurs except in chronically ill individuals, and by and large this appears to be true.

Hollenhorst and Wagener state that it seems to be definitely established that loss of blood is the ultimate cause of this catastrophic loss of vision. However, the exact mechanism through which the loss of blood brings about the lesions in the retina, optic nerves or visual pathways, has been the subject of much discussion and is still largely a matter of speculation. The essential factor responsible seems to be anoxia, which affects in some cases the tissues of the retina, in others the optic nerves, and in others the higher visual pathways. It is thought that this anoxia must be due to one or a combination of several different factors: deficiency of the oxygen-carrying capacity of the blood, inability of the tissues to utilize what oxygen is supplied, or insufficient flow of the oxygen-carrying components through the blood vessels, due to embolism, thrombosis, lowered blood pressure or reduced blood volume. No toxic factor has been demonstrated. Hollenhorst and Wagener quote the recent statement of S. Locket that this variety of visual loss would seem to occur when the blood volume has returned to normal, with a resulting fall in hæmoglobin and plasma protein values; of all the changes that occur in the blood after hæmorrhage, dilution of the blood by tissue fluids is the one that is most likely to require hours or even days to occur, and would most closely parallel the onset of delayed blindness. Thus, Locket states, in chronic illness there are three factors—anæmia, low plasma protein values and low body reserves of protein. Hollenhorst and Wagener regard as primary considerations the anæmia, reduction in blood volume, subsequent dilution of the blood with tissue fluids, and concomitant lowering of the plasma protein values discussed by Locket, and suggest that to these factors may be added slowing of the blood-stream in the retina associated with lowering of the blood pressure, in the presence of maintained intraocular pressure; this may result in relative ischæmia of the retina, or at times in actual thrombus formation in the central artery of the retina or in a branch arteriole. Anoxia usually causes dilatation of the arterioles; so, they state, the constriction of the arterioles seen in some of these cases is not likely to occur as a primary causative lesion, but rather as a compensatory effort to maintain normal capillary flow to the retina, or else as a late development associated with the atrophy of the retina and optic nerve.

Treatment is usually directed towards the correction of two conditions, firstly the loss of blood, and secondly the lesion responsible for the bleeding. Prompt blood transfusion, especially when the concentration of hæmoglobin falls to less than 50%, is strongly indicated. Striking improvement has been noted immediately after transfusions in certain cases, and no case has been found in the literature in which loss of vision followed adequate transfusion, except in cases in which the patients awoke blind after coma. However, when loss of vision has occurred, immediate transfusion is no insurance against further loss, nor does it guarantee recovery. The importance of control of bleeding is shown by the many cases in which further hæmorrhage subsequent to the loss of vision caused even further blindness. The value of local treatment of the eye is debatable. Duke-Elder has stated that paracentesis of the eye may be used to lower the intraocular pressure, in an attempt to improve the retinal circulation and restore vision. Hollenhorst and Wagener consider that the wisdom of the use of vasodilators immediately after the loss of vision is open to question. After bleeding has ceased and the blood and blood pressure have returned to normal, vasodilators may be of value in stimulating return of function to any of the retinal ganglion cells or nerve fibres which have not undergone complete degeneration. However, as with so many other conditions, the really important phase of treatment appears to be that of prevention. The possibility of occurrence of this rare disaster may be added to the other important indications for early transfusion after severe hæmorrhage. There is probably no very effective treatment once blindness has occurred.

[1] *The American Journal of the Medical Sciences*, February, 1950.

Abstracts from Medical Literature.

SURGERY.

Cleanliness of Surgeons' Aprons.

D. C. CORRY (*The Lancet*, May 13, 1950) states that at the Radcliffe Infirmary, Oxford, surgeons' aprons after use have been scrubbed with soap and water, soaked in 2% "Lysol" solution for a few minutes, rinsed in water and hung in the open to dry. Cultures prepared from swabs taken from six aprons contained a heavy growth of organisms including staphylococci, Proteus, aerobic spore-bearers and micrococci. The length of time of soaking in 2% "Lysol" solution was increased to one hour, care being taken that the whole apron is covered; since then repeated culture of material from swabs has produced only a slight growth of *Staphylococcus albus* on one occasion.

Suture Materials for Lung Tissues.

A. R. VALLE AND G. B. MIDER (*The Journal of Thoracic Surgery*, February, 1950) have studied the reaction of the lung parenchyma of dogs to six different suture materials and the effects of these materials on healing. The materials tried were catgut, chromicized catgut, silk, linen, nylon and cotton, and of these the first three were thought most suitable.

Artificial Aortic Valves.

J. M. CAMPBELL (*The Journal of Thoracic Surgery*, February, 1950) describes an artificial aortic valve, made of methyl methacrylate, which has been placed surgically within the aorta in five dogs in which aortic regurgitation had been previously produced. The artificial valve was found to be a satisfactory corrective of the lesion: three of the dogs died of surgical complications, but two survived, and when subsequently killed were found to have only minimal tissue reaction at the site of the valve and no evidence of thrombosis.

Division of the Ductus Arteriosus.

W. S. CONKLIN AND E. WATKINS (*The Journal of Thoracic Surgery*, March, 1950) state that ligation of the patent *ductus arteriosus* with a single strand of non-absorbable suture material is no longer an acceptable procedure owing to the possibility of incomplete obliteration of the duct and the tendency to its racanalization. They advance a method of dividing the duct, involving use of the Potts-Smith-Gibson clamp (originally designed for the creation of aorto-pulmonary shunt by suture).

Fracture of Ribs.

FRANK PHILLIP COLEMAN AND CUSTIS L. COLEMAN (*Surgery, Gynecology and Obstetrics*, February, 1950) state that 10% to 20% of patients with fractured ribs associated with pleural or lung complications die of their injuries. The treatment of fractured ribs has not been changed by the newer concepts of thoracic physiology, better anæsthesia, antibiotics and chemotherapy. Except for blocking of the intercostal nerves with "Novocain" to relieve pain, practically no contributions have been made to the subject during the past century. The treatment usually employed in the management of fractured ribs, consisting principally of strapping the chest or other methods of immobilization, not only is futile, but may be extremely harmful. The authors consider that severe pain, paradoxical motion of the chest wall, instability of fracture fragments of the lower six true ribs, and certain pleural and lung complications are imperative indications for internal fixation of fractured ribs by wire. Stable and sturdy fixation of transverse or oblique fractures can be attained by fixing the fragments with wire and a bone peg. Details of the operative technique are given with illustrations.

Geriatric Surgery.

HOWARD R. DUDGEON, JUNIOR (*The American Journal of Surgery*, March, 1950) makes a plea that more old people be given the benefit of surgery instead of its being assumed that little can be done for them. He states that more and more frequently surgeons are called upon to perform emergency and optional surgery on patients aged sixty years and above. Many of these patients require immediate attention for fractured hips, strangulated herniæ, acute appendicitis and many more conditions. This has become such a major problem that there is now a journal devoted solely to the care of the aged. In 1941 about 10% of the total population were in the over sixty years age group, and this percentage will gradually increase for a number of years as preventive medicine and modern surgery prevent death in the pre-sixty years age group. The danger of surgery in the group of sixty years and above has apparently been overrated; the yardstick we should use to measure age is not that of years, but the patient's physiological and pathological condition. These patients should be carefully prepared with saline and glucose, plasma and blood, and an estimation of their kidney and heart function made. The general indications for surgery in this group are as follows: relief of pain; control of life-endangering infections; mobilization of a patient out of bed, because the dangers of becoming bedridden with pneumonia or other complications are greater than the operative risk with, for example, internal fixation of fracture of the neck of the femur; excision of malignant growths; relief of gangrene in peripheral vascular disease; relief of chronic obstructive diseases, such as enlarged prostate and pyloric obstruction. The choice and careful use of anæsthetic and pre-anæsthetic drugs are of importance and are discussed by the author. A short report of 123 unselected cases is given; the immediate and late mortality rate was 15·4%.

Thrombophlebitis.

JAMES M. SULLIVAN AND BENEDICT R. WALSKE (*The American Journal of Surgery*, March, 1950) have studied the voluminous literature on the treatment of thrombophlebitis over the past five years and present a list of 123 references. They consider that the literature is very confusing, one method being supported enthusiastically by certain authors, and other methods just as enthusiastically by other men. They state that the active treatment of thrombo-embolic disease may take one or more of three forms, namely, the use of anticoagulant drugs, lumbar sympathetic nerve block and vein interruption. They attempt to evaluate these various types of treatment used either alone or in combination with the others over a period of two years. They conclude that for thrombophlebitis of the saphenous system ligation appears to be the treatment of choice; for early thrombophlebitis of the deep veins ligation gives maximum protection against embolism and is a relatively easy procedure in competent hands; ligation of the *vena cava* is a major procedure prone to end in serious post-operative sequelæ, and is to be recommended only in bilateral disease which extends into the *vena cava* or unilateral disease in which the clot cannot be sucked back through the femoral vein. Anticoagulant therapy is effective and has its place, especially in the treatment of thrombophlebitis of the deep veins. However, it does not give maximum protection against embolism and has the disadvantages of producing a hæmorrhagic state and of requiring frequent and accurate laboratory control.

Tantalum Plates for the Reconstruction of the Chest Wall.

J. M. BEARDSLEY (*The Journal of Thoracic Surgery*, March, 1950) describes the use of plates of tantalum to replace large defects of the supporting framework of the thoracic cage caused by the resection of tumours.

Intraabdominal Approach to Inguinal Herniorrhaphy.

PHILIP JACKSON (*The American Journal of Surgery*, April, 1950) enters a plea for the intraabdominal approach to inguinal herniorrhaphy. He states that while very many surgeons have described numerous and ingenious methods for repairing inguinal herniæ, only very few have proposed that the intraabdominal approach is far superior to the extraabdominal as a means of access to all the structures of the defect. Of these La Roque was the leading and most persevering advocate. The author presents the technique of his approach, with illustrations, and propounds 13 advantages for the approach.

Relaxed Inguinal Rings.

L. KRAEER FERGUSON AND MARK W. WOLCOT (*Annals of Surgery*, April, 1950) report their findings as to the significance of the relaxed subcutaneous inguinal ring. They state that this subject has been controversial for years with complete divergence of opinion as to its significance in subsequent hernia development. There has even been much disagreement as to what constitutes a relaxed ring. The authors accepted, for their studies, the definition of a relaxed ring as one which comfortably admitted an adult index finger. The material for the study was obtained from reviewing 4000 health records at a large university, and the period covered was 1937 to 1939 inclusive. A group of men not having relaxed rings examined during the same period was selected at random from the same group of records and served as the control group. Both groups were contacted later by letter and asked if they had or had not had a hernia repair. The follow-up period, therefore, ranged between nine and eleven years

from the date of examination. The age group was young (between seventeen and twenty-six years), and of the 4000 examined, 392 (9·8%) had relaxed rings. In the authors' study, 14 persons with relaxed rings developed herniæ over a period of nine to eleven years from the date of the original examination. In the same period, the control group, those not having relaxed rings, had eight hernia operations. The authors conclude that the prognosis of subsequent development of hernia can probably not be based on the presence of a relaxed inguinal ring. The presence of a patent sac is of prime importance, and lack of strength and snugness of an internal ring coupled with adequacy of the *transversalis fascia* and abdominal musculature is likewise more important than relaxation of the subcutaneous ring.

Disruption of Abdominal Wounds.

WILLIAM I. WOLFF (*Annals of Surgery*, April, 1950) defines disruption or dehiscence of a wound as a separation of any portion of a wound involving the anterior fascial sheath or deeper layers. He states that in 1700 consecutive laparotomies, the incidence of wound disruptions was 2·6%, or 45 disruptions; of these 39 were complete, that is, extended through all layers of the abdominal wall, and six involved only the anterior sheath so far as could be detected. A careful study was made of all cases and comparison made from the standpoint of parentage, race, presence of cancer, type of location of the incision, suture material and method of closure. Results were subjected to statistical and clinical analysis. Of systemic factors concerned, age, hypoproteinæmia and, to a lesser extent, race seemed to influence the frequency of dehiscence. Season of the year, vitamin *C* deficiency, anæmia and sensitivity to catgut did not appear significant determinants. Cancer could not be divorced from age and other factors as a predisposing cause. The type and location of the incision did not seem to affect the disruption rate materially in this group, except for the McBurney type of incision, which afforded a high degree of protection. However, the placing of a viscus, that is, performance of a colostomy, gastrostomy *et cetera* in the incision, increased the risk, while drains generally did not. Disruptions occurred in spite of retention sutures in several cases. The author points out that care and technique in wound closure are unquestionably extremely important factors in wound healing, atraumatic closure of the peritoneal layer being the most essential single aspect. Post-operative complications, particularly coughing and vomiting, are pernicious influences, and intensive efforts should be directed at their prevention and control. Early ambulation appeared to be without danger. The mortality in this series was 11·1%, and the author considers that many incisional herniæ result from unrecognized or concealed wound separations.

Malignant Tumours of the Testicle.

P. F. J. HICKINBOTHAM (*The British Journal of Urology*, June, 1950) has reviewed all cases of malignant testicular neoplasms treated in the Birmingham United Hospital between 1936 and 1946 in order to obtain prognostic and therapeutic impressions of this disease. He comes to the conclusion that the very gloomy view of these malignant growths which has hitherto been current is not fully justified by the figures and cases quoted in this review. A five-year survival rate of 32·3% for teratomata and 52·2% for seminomata is most encouraging. These figures apply to operable cases only. Similarly the case of an apparently hopeless malignant abdominal testis, or a metastasis, may be brought to an unexpectedly satisfactory conclusion by early and vigorous treatment. The present series indicates that orchidectomy, followed by irradiation of the gland fields, is the treatment of choice. Seminomata constitute about 50% of these neoplasms. The author states that seminoma shows remarkable uniformity of structure, and Chevasso believes that it is simply a growth arising from the spermatocytes or their predecessors. Ewing regards it, however, as a teratoma in which bone cell type has overgrown all the others. The common adult teratoma forms about 40% of these growths. It is invariably malignant, though it may lie dormant for long periods of time and then, perhaps from trauma, suddenly become highly malignant. It has a heterogeneous macroscopic and microscopic appearance, being derived from all three embryonic layers. The third main type is the adult embryoma, occurring in less than 1% of all testicle neoplasms and resembling an ovarian dermoid. It is congenital and non-malignant. As regards secondary growth, seminomata metastasize first to the lumbar glands, but teratomata invade blood vessels early and their metastases are usually first of all in the lungs. At operation it is wise to divide the spermatic cord at the internal ring in every case. When there is any doubt as to the diagnosis during the actual operation, it is wiser to risk excising a normal organ than to risk dissemination by incising the tumour.

Xylocaine in Local Anæsthesia.

D. M. CARNEGIE AND A. J. H. HEWER (*The Lancet*, July 1, 1950) report the results of a clinical trial of the Swedish local analgesic, xylocaine. They have used it in 138 cases and state that it is a relatively non-irritant analgesic substance of low relative toxicity with rapid onset and prolonged duration of action. In a concentration of 0·5% with adrenaline it produces almost as long a period of analgesia as 2% solutions. Tactile as well as pain sense is lost. It can be used for topical as well as infiltration analgesia. In the eye it produces no dilatation of the pupil or mistiness of the cornea. An adrenaline dilution of 1 in 250,000 is more suitable than one of 1 in 100,000. The dosage of xylocaine is the same as for procaine with a maximum of one gramme, although as a rule lower concentrations of xylocaine are satisfactory.

Neurosurgical Control of Pain.

J. C. WHITE (*The Lancet*, July 29, 1950) discusses the present position of the neurosurgical treatment of persistent pain with special reference to antero-lateral cordotomy, sympathectomy and prefrontal leucotomy. He states that it is obvious that we are still somewhat short of our goal of controlling all varieties of pain by neurosurgical intervention. There is as yet known no certain method for the specific interruption of the pain pathways in some of the post-amputation phantoms, especially in the upper limb, for pain following injuries of the spinal cord (as distinguished from the *cauda equina*), or for the burning *hyperæsthesia* of the thalamic syndrome. Furthermore, even the most trusted operative procedures may fail: cordotomy by late falls in analgesic level, and sympathectomy by regeneration of visceral afferent neurons. To solve these particular problems, animal experimentation is of little value; more reliance must be made on direct observations on the conscious human patient. Here only the scientific curiosity and physiological ability of surgeons can advance our knowledge.

Fatalities following Administration of Curare.

R. FOREGGER (*The Journal of the American Medical Association*) reports three fatalities considered to be due to a dangerous side action of curare. He has found from a partial review of the literature references to 19 fatalities following the use of curare, and also several near fatalities; they are considered to be due to the same side action of the drug. The author states that the incidence of fatal reactions with curare is low, and its value in medical practice assures continued usage. The observations of the present survey suggest that further study is needed so that suitable means may be found to counteract undesirable toxic reactions when they occur. At the present time available knowledge suggests that the antihistaminic drugs and procaine may be helpful in treatment of respiratory complications of curare administration.

Male Genital Tuberculosis.

P. L. SCARDING, R. A. KELLY AND W. W. SCOTT (*The Journal of Urology*, April, 1950) discuss their experience with radical excision of various parts of the male internal and external genital organs, when affected by tuberculosis. They state that there are some cases in which widespread excision of the "seminal tract" is called for, especially since tuberculosis of the prostate and of the seminal vesicle sometimes progresses in spite of epididymectomy. According to W. Boyd the infection is hæmatogenous, and may start in the head or the tail of the epididymis, or in the prostate or the vesicles. The introduction of streptomycin has led to many clashes of opinion about its efficacy in this disease, but it seems to be tuberculostatic rather than tuberculocidal. In the authors' operative experience, the pre-operative use of streptomycin does not affect tuberculous lesions in this tract. It does, however, close skin sinuses in the scrotum or perineum very effectively, and also seems to be able to prevent the occurrence of sinuses after excision of various parts of the genital tract. The authors have made a tabulation of their results in various types of radical and conservative operations, but, owing to the great variation in the pre-operative condition of the patients, a useful comparison of the value of the two types of surgical treatments is not really permissible. The results with simple epididymectomy are undoubtedly good, being 100% satisfactory when streptomycin is used as well. The chief risks in advanced cases are miliary tuberculosis, tuberculous meningitis and pulmonary tuberculosis.

British Medical Association News.

SCIENTIFIC.

A MEETING of the New South Wales Branch of the British Medical Association was held on September 21, 1950, at Sydney Hospital. The meeting took the form of a series of clinical demonstrations by members of the honorary medical and surgical staff of the hospital.

Aneurysm of the Aorta.

DR. E. H. STOKES discussed the case of a man, aged sixty-three years, who was suffering from an aneurysm of the arch of the aorta. During the past two years the patient had been troubled by a dull pain in the region of the left scapula. Since January, 1950, the pain had become progressively worse and at times was very acute. He also suffered from breathlessness on exertion, cough, hoarseness and difficulty in swallowing. On examination of the patient cough of the "gander" or "brassy" type was evident. Pulsation was noted on palpation in the second right intercostal space and a systolic murmur, a booming second sound and a diastolic murmur were evident over the aortic area. (Dr. Stokes played a gramophone recording of these sounds.) Just medial to the cardiac apex, which was displaced slightly outwards from its normal position, the presystolic murmur first described by Austin Flint was audible. The brachial blood pressure readings were 114 millimetres of mercury, systolic, and 96 millimetres, diastolic, on the right side, and 100 millimetres, systolic, and 70 millimetres, diastolic, on the left side. The left vocal cord was seen to be in the cadaveric position. On X-ray examination the shadow of an aneurysm somewhat larger than a cricket ball was seen. The blood serum gave a positive reaction to the Wassermann test. After preliminary treatment with a mixture containing 10 grains of potassium iodide and one drachm of *Liquor Hydrargyri Perchloridi*, the patient was given 10 intramuscular injections of "Rubyl" (dose 3·5 millilitres) at intervals of three days. Following this course 20 million units of penicillin in oil were administered, 600,000 units being the daily dose. Dr. Stokes said that the treatment had been completed about three months before the meeting and the patient's condition had improved slightly; the dyspnœa and pain had diminished. Treatment with the mixture was being maintained.

Aortitis Treated with Penicillin.

Dr. Stokes's next patient was a woman, aged fifty-seven years, who had been in Sydney Hospital on several occasions on account of aortitis. She had entered hospital on December 13, 1949, her principal symptoms being breathlessness aggravated by exertion, tightness in the upper part of the chest, and fatigue. On examination of the patient the typical systolic-diastolic (to-and-fro) murmur of aortic regurgitation was audible. On percussion the aortic dulness was not increased, but the left ventricle was considerably enlarged. A typical Corrigan type of pulse was present, the blood pressure readings being 200 millimetres of mercury, systolic, and 60 millimetres, diastolic. The right common carotid artery was kinked. The blood serum gave an anti-complementary response to the Wassermann test, but the Kahn reaction was strongly positive. At first the patient was treated with a mixture containing ten grains of potassium iodide and one drachm of *Liquor Hydrargyri Perchloridi*, given three times daily. Then a course of ten intramuscular injections of "Rubyl" (dose 3·5 millilitres) was administered at bi-weekly intervals. Finally she was given 20,000,000 units of penicillin in oil intramuscularly in daily doses of 600,000 units. Dr. Stokes commented that although the patient had shown a remarkable symptomatic improvement after treatment, the blood serum yielded a completely positive response to the Wassermann test.

Thyreotoxicosis Treated with Methyl Thiouracil.

Dr. Stokes then showed a man who had been treated for thyreotoxicosis with methyl thiouracil. The patient had been shown at previous meetings of the British Medical Association held at Sydney Hospital. He had received no treatment for three years. He did not complain of any symptoms. His general condition was excellent. The thyreoid gland was just palpable. The serum cholesterol content was 275 milligrammes per 100 millilitres. Before seeking treatment in 1944 the patient's chief complaints had been of loss of weight, excitability and shakiness. His highest basal metabolic rate had been +50%, and his lowest serum cholesterol content 128 milligrammes per 100 millilitres.

Clinical Photographs.

Dr. Stokes finally showed a series of photographs of patients, X-ray films, electrocardiograms and phonocardiograms. The photographs had been taken by Mr. L. W. Appleby, photographer to the Sydney Hospital.

Sterility.

DR. R. H. MACDONALD showed a married woman, aged twenty-seven years, who had reported to the gynæcological out-patient department on August 24, 1948. She complained of infertility in her second marriage. She had had a miscarriage at five months' gestation in her first marriage in 1940. During the two and a half years of her second marriage she had used no contraceptives and had been anxious to conceive. She had had no illness or operations. Her menarche had occurred at the age of fourteen and a half years. Her menstrual periods were irregular, the intervals varying between twenty-eight and ninety days, the loss was slight and the periods lasted from four to five days. Her last menstrual period had begun on August 17, 1948.

On examination, the patient was found to be slightly obese, and the pubic hair was of male type of distribution. There was some hair over the sternum and surrounding the nipples. Facial hirsutism was pronounced. The patient said that these changes had appeared since her marriage in 1940. Her breasts were well developed. No abnormalities were detected in the vulva or vagina. Examination of the cervix revealed an old triradiate laceration. The uterus was anteverted and showed evidence of hyperinvolution. Both ovaries were palpable.

The following reports of investigations carried out at The Royal Infirmary, Chester, were available.

On March 19, 1947, a salpingogram with lipiodol had shown the Fallopian tubes to be patent. On May 12, 1947, endometrial biopsy revealed poorly developed stroma, and no secretion in the glands. The occurrence of an anovulatory menstrual cycle was presumed. The husband's semen was examined (two millilitres). It contained 5,200,000 sperms per millilitre, the initial motility being 66% and motility ceasing in twenty-four hours. The percentage of normal forms was 85; oligospermia was present. The patient had been given "Serogan" intravenously, 1000 units on two occasions in mid-cycle every month for four months.

The Sydney Hospital investigations were as follows.

On August 28, 1948, the excretion of 17-ketosteroids in the urine was estimated to be 11·5 milligrammes in twenty-four hours. Excretion pyelography and urography showed that both kidneys functioned well and appeared normal. A plain X-ray film revealed no abnormality. On September 9 an endometrial biopsy was taken; there was no evidence of secretory change in the glands, a few of which were dilated and lined by partially ciliated epithelium. Near parts of the surface the stroma consisted of large cells and contained scattered lymphocytes. On July 17, 1949, the basal metabolic rate was +1%. On July 27 an X-ray examination of the skull showed the outline of the *sella turcica* to be regular; no lesion was seen in the cranial part of the skull.

No loss of blood *per vaginam* occurred from November, 1948, to April 28, 1949. Hæmorrhage occurred on that date and again on June 17, 1949. On each of these occasions the flow continued for four days. These incidents of bleeding were induced by œstrogen therapy. In July, 1949, the patient was referred for stimulating doses of X-ray therapy. Treatment was given as follows: small doses of medium-voltage X-ray therapy were delivered to the pituitary gland, thyreoid gland and both ovaries once a week for three weeks. The pituitary gland was treated alternately from the right and left lateral fields, the thyreoid by a direct antero-posterior field and the ovaries by a direct antero-posterior field. The dose in "V" units to each organ was very low. Hæmorrhage occurred on October 3, 1949, after some months of amenorrhœa. Further hæmorrhage occurred in November, 1949, and on January 27, 1950, on March 7, 1950, on April 13, 1950, on May 10, 1950, and on June 6, 1950. These episodes were accompanied by slight pain and discomfort and lasted for four to five days, and her weight was reduced by 11 pounds from thirteen stone to 12 stone three pounds. An endometrial biopsy was taken on May 23, and this specimen showed the endometrium to be in a proliferative phase (thirteen days from the onset of the previous menstrual period). A further biopsy was taken on May 30 (twentieth day of the cycle), and secretory changes were present in the endometrial glands.

The Surgery of Dyspepsia.

DR. J. M. YEATES showed a series of patients to illustrate the surgery of dyspepsia.

The first patient was a man, aged forty-two years, who one week before his admission to hospital had had an attack of pain in the umbilical region associated with nausea. He was admitted to hospital on the night of June 5, 1946, with a further attack. On that occasion the pain was most severe and vomiting occurred. There was a previous history of flatulent dyspepsia.

Examination of the abdomen revealed a smooth, tender, rounded mass in the right iliac fossa. There was some doubt as to its nature, but an appendiceal abscess seemed likely. At operation the mass was found to be the fundus of a long, distended gall-bladder. Several ounces of fairly clear fluid were aspirated, a large stone was removed and a drainage tube was introduced. The resulting fistula healed surprisingly quickly (June 20) and the patient was discharged from hospital. During the intervening four years he had been free from all symptoms and denied even the slightest dyspepsia. A cholecystogram prepared one week prior to the meeting showed fair concentration of the dye in the still very large gall-bladder.

Dr. Yeates said that the patient was not interested in a cholecystectomy. The case showed that the rather outmoded operation of cholecystostomy could, on occasion, be attended by a satisfactory result. It could not be denied, however, that the conditions which produced the stone were still presumably present.

Dr. Yeates's second patient was a thin man, aged fifty-two years, who had endured attacks of severe generalized abdominal pain for twenty-eight years. There was no history of nausea, vomiting, dietary restrictions nor dyspepsia except the mildest flatulence. X-ray examination revealed a gall-stone in the gall-bladder. Cholecystectomy was performed in December, 1946. This abolished the pain and the patient was completely satisfied.

Dr. Yeates said that the patient had been selected for demonstration because it was thought that he belonged to a group in which removal of the gall-bladder could be guaranteed to give total satisfaction, in contrast to the group in which dyspepsia was severe and might be persistent after operation. The more closely one studied patients after operation, the more one realized that cholecystectomy abolished the pain of gall-stones, but perhaps only diminished concurrent dyspepsia.

The next patient shown by Dr. Yeates was a wharf labourer, aged sixty-two years, who had had a history of duodenal ulcer for about fourteen years. The diagnosis had been definitely made by X-ray examination six years earlier. Medical treatment had not been satisfactory, severe pain in the centre of the abdomen being frequent. Perforation occurred in April, 1947. This was treated by simple suture. For three months all was well; then the pain recurred and was worse than ever before. Vomiting and general weakness added to the patient's trouble, rendering hard work impossible. Subtotal gastrectomy was performed in October, 1948. Examination of the specimen revealed the presence of a gastric ulcer on the lesser curvature, which had never been diagnosed. Relief after operation was striking. The patient returned to work on the waterfront. During the last two years he had led a life without restrictions. He smoked tobacco and drank alcohol fairly heavily.

Dr. Yeates's last patient was a man, aged fifty-two years, who had been diagnosed radiologically as having a duodenal ulcer in 1940. A fractional test meal examination at that time showed "high acidity". The patient did not take kindly to medical treatment. He smoked constantly and did not stick to his diet. In January, 1947, perforation occurred. The perforation was sutured at the Royal Prince Alfred Hospital by Dr. Mills. A barium meal examination three months later showed that the ulcer was "active". In October severe hæmatemesis occurred and his hæmoglobin value fell to 30%.

The patient first attended Sydney Hospital in March, 1948. He complained of severe pain in the epigastrium, worse at night and relieved by milk. He still smoked heavily. On examination it was seen that he was pale, thin and haggard. He said that even minor worries seemed to affect the "nerves of his stomach".

Operation was performed in April, 1948. The diagnosis of chronic duodenal ulcer was confirmed. Vagotomy and gastro-jejunostomy were carried out. (Drainage of the stomach was considered advisable because some degree of duodenal stenosis was already present.) Slight diarrhœa was present for several weeks after operation. Pain was immediately abolished and did not return. During the next six months the patient gained nearly two stone in weight. He found no need for any restrictions in his diet, and he no longer felt the "nerves to his stomach" upset by trifles as before. To his immense satisfaction his bowels worked easily once a day, whereas for many years he had endured obstinate constipation. A recent fractional test meal examination revealed a very low acid curve.

Dr. Yeates said that it was interesting to contrast this patient with the previous patient. At the moment both were equally satisfied. A large volume of statistics was piling up which suggested that the patient who underwent gastrectomy was the more likely to remain satisfied.

Thiersch's Operation for Rectal Prolapse.

DR. R. J. W. MALCOLM and DR. T. E. WILSON showed a female patient, aged seventy-nine years, who had undergone operations for rectal prolapse in 1924 and in 1931. In 1933 the condition recurred. Prolapse of the rectum would take place after defæcation or straining, but she was able to replace it without difficulty. She suffered from incontinence of fæces for many years. After a fall twelve months before the meeting the prolapse increased in degree and became more difficult to reduce. On April 6, 1950, Thiersch's operation was performed under local anæsthesia. On April 23 she was discharged to her home; the action of her bowels was regular with glycerin suppositories and she had no prolapse. No post-operative pyrexia had occurred. On May 2 the perianal wire was exposed posteriorly, and the patient complained of some pain. On June 20 the perianal wire was changed. Some perianal fibrosis was present. One week later she was discharged to her home with her condition satisfactory. She had had no prolapse since then and no pain. Her bowels were regular in action.

Transthoracic Vagotomy.

Dr. Malcolm and Dr. Wilson next presented a married woman, aged sixty-seven years, who in 1940 had undergone gastro-jejunostomy and excision of a gastric ulcer, and in 1945 laparotomy, because of a penetrating ulcer of the lesser curvature of the stomach. Partial gastrectomy was not performed because of dense adhesions. During the past ten years she had had several hæmatemeses. During the twelve months prior to the meeting she had complained of severe epigastric pains coming on about an hour after meals and relieved by food and antacids. She had suffered some loss of weight previously, but was gaining again in the current year. Examination of the patient revealed good general condition, with no abdominal tenderness, rigidity or palpable mass. A fractional test meal revealed 48 units of free resting acid; otherwise the curve was normal. X-ray examination after a barium meal revealed a large gastric ulcer just proximal to the stoma; it appeared to be active. Her hæmoglobin value was 13·8 grammes *per centum*. A Ryle's tube was inserted and the stomach aspirated prior to operation on February 28, 1950, when two inches of vagi and branches were removed from the lower end of the œsophagus through an incision in the bed of the left eighth rib. Penicillin (50,000 units three-hourly) was given for the first seven days after operation; no pyrexia occurred. The stomach was kept empty by aspiration for four days after operation, and fluids were given by intravenous infusion. Then feeding was started with milk and water hourly, and the diet was gradually increased. On March 23 an insulin test meal was carried out; after the injection of 20 units of insulin the gastric contents were aspirated every ten minutes for an hour; in one specimen the free hydrochloric acid level was 10 units, in the others no free hydrochloric acid was present. On March 25 the patient was discharged to her home with much less pain than when she had been admitted to hospital. She was to continue receiving an "ulcer" diet, "Amphogel", phenobarbitone and tincture of belladonna.

Ano-Rectal Abscess and Fistula.

The next patient presented by Dr. Malcolm and Dr. Wilson was a man, aged forty-nine years, who had been admitted to Sydney Hospital on July 29, 1950. He stated that he had had a "boil" to the right of the anus in 1941. The action of his bowels was regular with paraffin. For the past nine weeks he had had a feeling of fullness and discomfort to the left of the anus; then an abscess had formed and burst. Examination of the patient revealed a tender indurated area in the right buttock and similar induration around the ano-rectal ring. Simple stricture of the bowel was present at the ano-rectal ring with a red, firm polypus anteriorly. Biopsy of the polypus showed no evidence of malignancy. The specimen consisted of œdematous actively

inflamed scar and granulation tissue with damaged mucosa on parts of the surface. X-ray examination of the chest revealed no abnormality. The hæmoglobin value was 10·9 grammes *per centum*. "Polyhæmen" tablets were prescribed. On August 1 operation was performed. On the right side of the anus a wide excision was made about the external opening of the sinus, which was then traced upwards and found to bifurcate, one portion passing upwards through the *levator ani* muscle, the other passing to the region of the polypus with an extension posteriorly and to the other side. The latter appeared to run between the pubo-rectalis muscle and the deep part of the external anal sphincter; but, as there was some doubt as to its position, a piece of thread was passed through the track and loosely tied. No foreign body was found. The wound was then irrigated daily with "Eusol" and dressed with "Eusol" gauze. On August 15 the incision was extended to the left buttock, where a considerable quantity of fat was removed from the ischio-rectal fossa. Extensions of the sinuses to the left were opened and curetted. The portion of the sinus through which the thread had been passed was opened, and the deep part of the external anal sphincter muscle was divided. An apparently localized mass of fibrous tissue was dissected out in the process; the pathologist reported that this mass contained a considerable amount of scar tissue among the muscle fibres; a fragment of the rectal mucosa with chronic inflammatory changes was included. No evidence of new growth was found. Daily baths were given, following which the wound was again irrigated with "Eusol". It was dressed with "Eusol" gauze at first, later with red lotion. On September 6 the hæmoglobin value was 10·5 grammes *per centum*. On August 29 examination was carried out under "Pentothal" anæsthesia; the wound was flat and satisfactory. By September 18 the anal sphincter control was gradually recovering. The patient was exercising the sphincter. A fæcal impaction was removed.

Colectomy for Chronic Ulcerative Colitis.

Finally Dr. Malcolm and Dr. Wilson presented a man, aged thirty-seven years, who was stated to have had "colitis" in 1938. In 1939 he had undergone an operation for hæmorrhoids and anal fistula. In 1940 he had undergone caecostomy because of anal stricture. That was followed by vesico-colic fistula, which was treated by transverse colostomy, the abdomen being first explored through a right lower paramedian wound and the caecostomy then closed by operation. Since 1940 he had complained of pain in the right hip. In 1946 he had an attack of jaundice. In 1949 the pain in the right hip was more severe. A tender swelling was present over the right greater trochanter. The transverse colostomy opening, which was of the loop type, was retracted level with the skin. The anus admitted a finger tip only. The anal mucosa was red and friable; there was no mucus or pus present, but some blood. A narrow stricture was present six centimetres from the anus. In the proximal limb of the colostomy, the mucosa was slightly red; no mucus, pus or blood was present. In the distal limb of the colostomy was a stricture eight centimetres from the skin. No ulcers were seen in the mucosa, but much mucopus was present. The patient complained of pain and the feeling of air in the swelling over the right hip when air was blown into the distal limb of the colostomy. Pressure over the right greater trochanter caused pus to run from the anus. On January 24, 1950, left hemicolectomy was performed. The colon was removed from the transverse colostomy to the lower end of the sigmoid colon. The upper end of the remainder of the sigmoid colon was brought out through the lower end of the abdominal wound. The pathologist made the following report:

> Portion of a narrow, rather thick-walled colon, 39 cm. long, was received. In places the lumen was almost obliterated. Elsewhere it contained some bloodstained material resembling pus. The mucosa was thin, but no ulcers were visible. Microscopic examination: Chronic inflammatory changes are most conspicuous in the mucosa, where there is scarring, infiltration with lymphocytes, eosinophils, and plasma cells, and formation of numerous lymphoid follicles. The other coats are affected to a less extent. There are a few focal lesions with cells resembling epithelioid cells, but no caseation. These may be a reaction to foreign material entering through previous ulcers in the mucosa. No parasites have been found.

Convalescence was uneventful. On March 4 the hæmoglobin value was 12·7 grammes *per centum*. On March 28 perineal excision of the rectum and the remainder of the sigmoid colon was carried out. The pathologist submitted the following report:

> The specimen consisted of the anal canal and portion of the rectum 9·5 cm. in length. The lumen of the bowel was much reduced and 3 cm. from the proximal end was narrowed to an extreme degree. The distal 5 cm. of bowel was packed with a gauze swab. Microscopic examination: The rectal lining is formed of actively inflamed granulation tissue and there is purulent exudate in the lumen of the bowel. Lymphoid follicles with germinal centres are present in the muscle coat, which is thickened by fibrous connective tissue.

Two weeks after the operation the suprapubic wound was healed and the perineal wound was healed with the exception of the anterior half-inch. That remained unhealed, and a small amount of discharge persisted from it until August 1. Since then the wound had remained healed. On August 15 the patient's general condition was very good. A small incisional hernia was present at the lower end of the abdominal wound at the site of previous implantation of bowel. The mucosa of the transverse colon was redder than normal and showed loss of vascular pattern. Some excess mucus was present on the mucosa.

Pulmonary Collapse.

DR. W. L. CALOV, DR. I. R. RITCHIE, DR. A. B. S. HOGAN and DR. M. DECK showed a series of patients with segmental and lobar pulmonary collapse. The radiographic diagnosis was discussed. It was pointed out that a lung or a portion of a lung would collapse (i) when it was allowed to relax, (ii) when it was compressed, and (iii) when the bronchus supplying it with air was obstructed. The three types of collapse might be called relaxation collapse, compression collapse and absorption collapse. The first occurred when, for example, air entered the pleural space (spontaneous or artificial pneumothorax). The lung fell away from the thoracic wall and shrank merely by the elastic recoil of its tissues. The compression type of collapse might result if in artificial pneumothorax the air was forced in with too much pressure; it might also occur in the spontaneous tension pneumothorax in which a valve-like opening appeared in the visceral pleura. But compression collapse was most often caused by the collection of fluid or of air and fluid in the pleural space. When a bronchus was blocked by a neoplasm or a foreign body or a plug of mucus or inspissated pus, the air was absorbed from the lung tissue supplied by the bronchus, and that lung tissue collapsed. The negative pressure increased in that affected lung or portion of lung, whether lobule, segment or lobe. The tendency therefore was for the material in the bronchus to be sucked towards the periphery. As a result of that suction, a foreign body would be jammed more tightly into the bronchus; pus or mucus would be sucked down and would perhaps break up, entering smaller passages, perhaps even the terminal bronchioles. In any case, the affected portion continued to be denied air. If the cause of collapse was removed early enough, complete reexpansion of the pulmonary tissue occurred. In relaxation collapse, complete or almost complete, reexpansion might occur even when the cause (such as artificial pneumothorax) had been present for a number of years. The reexpansion in such a case depended on the extent of the pulmonary disease and the state of the visceral pleura. If the visceral pleura had become thickened and had lost its elasticity, complete reexpansion was impossible. In compression collapse complete reexpansion after a long period was less likely than in relaxation collapse. In absorption collapse the degree of reexpansion depended on infection and consequent fibrosis. If fibrosis had not occurred reexpansion might be complete. If the obstruction causing absorption collapse could not be removed, or if fibrosis had occurred and the collapse was permanent, traction by adjacent healthy pulmonary tissue caused dilatation of the bronchi in the fibrotic mass. That was bronchiectasis. Among the causes of bronchial obstruction might be mentioned the following: foreign body, stenosis following ulceration caused by foreign body or infection, bronchogenic neoplasm, pus or dried mucus, pressure from mediastinal glands or tumour, pressure from aortic aneurysm.

Obituary.

EDWARD ALBERT WOODWARD.

EDWARD ALBERT WOODWARD, M.C., E.D., M.B., Ch.M. (Syd.), M.R.A.C.P., died at Grafton, New South Wales, on October 5, 1950. He was born in Melbourne only fifty-five years ago, educated at Toowoomba Grammar School, where he won the

University of Sydney medals in 1910 for first place in the junior examination in Latin and Greek, and then at the Sydney Church of England Grammar School, North Sydney, where in 1912 he again won the university medals for first place in Greek, Latin and English in the senior examination. Though awarded the Cooper Classical Scholarship, he decided instead to do medicine, and here again he had the same scholastic success. He had other interests also, and in his second year he stroked the 'varsity crew, played in the first fifteen, and continued rifle-shooting, in which he had been outstanding since as a boy of fourteen years he had won the Queensland Roe matches in open competition against all comers. During the medical course he also maintained his interest in literature and the classics; and in addition, accepted a succession of appointments on the Undergraduates' Association, the Medical Society, and Saint Andrew's College Committee. He also held a commission in an infantry battalion of the Citizen Military Forces.

When the war came, medical undergraduates were prevented from enlisting, but he graduated in 1917 near the top of the honours list. Instead of taking a year's teaching hospital appointment, he chose a short residency at the Coast Hospital, thus managing to get the sooner to France, where he was regimental medical officer to the 29th Battalion and later with the 8th Field Ambulance. While in France he was awarded the Military Cross.

After a short period of training in London, mostly at Great Ormonde Street, he returned to New South Wales, brought a practice at Emmaville and married Elizabeth McDougall, of Toowoomba, with whom he shared a very happy life. Then in 1922 he moved to Grafton and joined Dr. E. P. Holland, who had been with him at Saint Andrew's College, in partnership there.

In Grafton his diversity of interests showed again. He became president of the Grafton Club while still a young man and was annually reelected for many years; over a similar long period he was chairman of the Clarence River Jockey Club. He was also chairman of the Northern Rivers Racing Association, a foundation member of Grafton Rotary, and for one year its president, the coach to the Grafton Rowing Club, a member of the Grafton Golf Club, of a literary society called the Odd Volumes Club and of the Grafton Library Committee, chairman of the Grafton branch of the National Fitness Council, and a founder and supporter, with others, of "Rathgar", a home for children at South Grafton. During his time at Grafton he took a consistently active part in the army, beginning as a troop leader in the 15th Light Horse Regiment and becoming eventually a lieutenant-colonel and its commanding officer.

About the end of the 1920's the partnership was expanded into a group practice, in which each member developed a special interest; his became clinical pathology. In 1939 he was in Sydney for six months, and during this time he passed the M.R.A.C.P. examination.

When the second World War broke out, he was offered command of a unit, but was rejected as medically unfit. Nevertheless, he continued in general practice with his group of partners, now reduced in number. Soon he was commanding the 2nd Battalion of the Volunteer Defence Corps, and later he was appointed to command the Northern Rivers Brigade. On the lighter side during the war years was the racing of a number of horses both locally and in Brisbane in partnership with his medical partner, Dr. E. P. Holland, and his brother-in-law, Mr. D. W. McDougall. One of these horses, Common Sense, won many races, including the Brisbane Handicap.

His love of the classics gained expression during these years also; he translated into English verse, preserving the Latin metre, much of Horace, Catullus and Lucretius. He also translated some Greek verse, translated occasional humorous English verses into Latin verse, and wrote several original poems in English.

In 1946 failing health compelled him to give up general practice. He was, however, able to carry on a small practice as pathologist, and did this until the time of his death, which, after so many threats, came in the end suddenly and peacefully.

In 1947 he had written an original poem on the theme of *"Et In Arcadia Ego"*, showing resignation toward death, which he then knew could not be far off, and joy of living. At a simple service in the Grafton Cathedral, where six of the city's doctors acted as pall-bearers, this poem was read by the Dean.

DISEASES NOTIFIED IN EACH STATE AND TERRITORY OF AUSTRALIA FOR THE WEEK ENDED OCTOBER 28, 1950.[1]

Disease.	New South Wales.	Victoria.	Queensland.	South Australia.	Western Australia.	Tasmania.	Northern Territory.[2]	Australian Capital Territory.	Australia.[3]
Ankylostomiasis	*	1	3	..	..	..	..	..	4
Anthrax	*	..	*	*	*	*	..	*	..
Beriberi	*	*	*	*	*	*	..	..	..
Bilharziasis	*	..	..	..	..	..	..	..	..
Cerebro-spinal Meningitis	1	..	5(1)	..	..	1(1)	..	..	7
Cholera	..	..	..	..	..	..	..	..	..
Coastal Fever(*a*)	*	*	..	*	*	*	*	*	..
Dengue	*	*	*	*	*	*	..	*	..
Diarrhœa (Infantile)	..	..	..	..	..	..	..	..	..
Diphtheria	7(6)	7(3)	8(5)	..	6(6)	4	..	..	32
Dysentery (Amœbic)	*	..	..	..	2(2)	..	*	1	4
Dysentery (Bacillary)	*	1(1)	..	..	..	..	..	..	..
Encephalitis Lethargica	..	..	..	..	..	..	..	..	..
Erysipelas	*	*	*	2(2)	*	*	..	..	2
Filariasis	*	..	..	..	..	..	..	..	..
Helminthiasis	*	..	*	*	*	*	*	*	..
Hydatid	*	..	*	*	*	*	*	..	..
Influenza	*	*	*	..	*	*	..	*	1
Lead Poisoning	*	*	1	*	*	*	*	*	1
Leprosy	..	..	..	..	..	..	..	..	..
Malaria(*b*)	*	..	..	..	..	..	..	..	..
Measles	*	*	*	595(297)	*	*	..	..	595
Plague	..	..	..	..	..	..	..	..	..
Poliomyelitis	13(5)	3(1)	5(1)	1(1)	4	1(1)	..	..	27
Psittacosis	*	..	*	..	*	*	*	*	..
Puerperal Fever	..	..	..	..	..	..	..	..	..
Rubella(*c*)	*	*	*	*	*	*	..	..	..
Scarlet Fever	19(9)	19(11)	11(10)	8(8)	5(4)	4(2)	..	..	66
Smallpox	..	..	..	..	..	..	..	..	..
Tetanus	*	..	..	*	*	*	*	*	..
Trachoma	*	..	*	*	*	*	*	*	..
Tuberculosis(*d*)	18(12)	21(13)	10(5)	8(4)	13(7)	4(1)	..	..	74
Typhoid Fever(*e*)	..	1(1)	..	..	..	..	..	..	1
Typhus (Endemic)(*f*)	..	..	2	..	..	..	..	..	2
Undulant Fever	1	..	..	..	..	..	..	..	1
Weil's Disease(*g*)	*	*	..	*	*	*	*	*	..
Whooping Cough	*	*	*	5(4)	*	*	..	1	6
Yellow Fever	..	..	..	..	..	..	..	..	..

[1] The form of this table is taken from the *Official Year Book of the Commonwealth of Australia*, Number 37, 1946–1947. Figures in parentheses are those for the metropolitan area.
[2] Figures not available.
[3] Figures incomplete owing to absence of returns from the Northern Territory.
* Not notifiable.
(*a*) Includes Mossman and Sarina fevers. (*b*) Mainly relapses among servicemen infected overseas. (*c*) Notifiable disease in Queensland in females aged over fourteen years. (*d*) Includes all forms. (*e*) Includes enteric fever, paratyphoid fevers and other Salmonella infections. (*f*) Includes scrub, murine and tick typhus. (*g*) Includes leptospiroses, Weil's and para-Weil's disease.

Dr. E. P. Holland writes: Edward Albert Woodward had been my close personal friend for some thirty years and my partner from 1921 until he retired from active practice a few years ago to continue as a clinical pathologist in association with his colleagues in Grafton. We were closely associated in sporting and other activities, and our families grew up together.

It was my sad privilege to look after him during the last few years of serious deterioration of his health, and in my long years of general practice I have never had, under my care, a patient who was more cheerful and uncomplaining, and, in fact, kept his family and physician cheerful even when things were most gloomy. He was loved by all because he loved all and saw good in every man.

Scholar, physician and soldier, he possessed to a degree I have never before seen the qualities summed up by the late Sir William Osler in the word *aequanimitas*. The world is the better for his life and the worse for his passing, and he leaves a gap in the lives of those who enjoyed his friendship that will never be filled.

JOHN HUBBACK ANDERSON.

WE regret to announce the death of Dr. John Hubback Anderson, which occurred on November 5, 1950, at Ruthin, North Wales.

GEOFFREY TRAHAIR.

WE regret to announce the death of Dr. Geoffrey Trahair, which occurred on November 7, 1950, at Sydney.

Post-Graduate Work.

THE POST-GRADUATE COMMITTEE IN MEDICINE IN THE UNIVERSITY OF SYDNEY.

Course in Pædiatrics.

THE Post-Graduate Committee in Medicine in the University of Sydney will conduct a course in pædiatrics, under the supervision of Professor Lorimer Dods, in the lecture hall of the Royal Alexandra Hospital for Children, Camperdown, for one week beginning December 4, 1950.

Fee for attendance will be £3 3s., and those wishing to enrol are requested to communicate with the Course Secretary of the Committee, 131 Macquarie Street, Sydney, at an early date. Telephones: BU 5238, BW 7483.

The programme is as follows.

Monday, December 4: 9.30 a.m., "Immunization", Dr. Stephen Williams; 10.45 a.m., ward rounds; 11.45 a.m., "Acute Abdominal Emergencies", Dr. Eric Goulston; 2 p.m., "Minor Orthopædic Deformities and Their Management", Dr. R. L. Stephen; 3.15 p.m., "Common Skin Conditions in Children", Dr. Henry Sharp.

Tuesday, December 5: 9.30 a.m., "The Investigation of Intracranial Disturbances during Infancy and Childhood", Dr. M. Sofer Schreiber; 10.45 a.m., ward rounds; 11.45 a.m., "Croup and Allied Conditions", Dr. M. L. Edwards; 2 p.m., "Therapeutics", Professor Lorimer Dods; 3.15 p.m., "Bronchiectasis", Dr. J. M. Alexander.

Wednesday, December 6: 9.30 a.m., "Acute Diarrhœas of Infancy", Dr. W. P. MacCallum; 10.45 a.m., "The Treatment of Fractures Around the Elbow Joint", Dr. Laurence Macdonald; 11.45 a.m., "The Pale, Tired Child", Dr. D. G. Hamilton; 2 p.m., "Some Aspects of Pneumonia in Infancy and Childhood", Dr. Bryan Dowd; 3.15 p.m., "Psychiatric Problems in Childhood", Dr. D. W. H. Arnott.

Thursday, December 7: 9.30 a.m., "The Care of the Normal Full-Term Infant during the First Month of Life", Dr. Kathleen Winning; 10.45 a.m., ward rounds; 11.45 a.m., "Acute Hæmatogenous Osteomyelitis", Dr. J. Steigrad; 2 p.m., "Allergy", Dr. S. E. L. Stening; 3.15 p.m., demonstration of surgical cases, Dr. T. Y. Nelson.

Friday, December 8: 9.30 a.m., "Pyloric Stenosis", Dr. T. Y. Nelson; 10.45 a.m., ward rounds; 11.45 a.m., "Every-Day Pædiatric Problems", Dr. Charles Lee; 2 p.m., "Modern Trends in Pædiatrics", Professor Lorimer Dods; 3.15 p.m., "Minor Surgical Problems", Dr. C. J. Gibson.

Demonstration of Pathological Specimens.

An exhibition of pathological specimens, illustrating some aspects of tuberculosis in children, will be set up in the lecture theatre of the hospital by the director of pathology, Dr. Douglas Reye.

Medical Appointments.

Dr. Bernard Nicholson has been appointed honorary assistant to the director of the psychiatric clinic of the Royal Adelaide Hospital, Adelaide.

Dr. Charles Spencer Swan has been appointed honorary clinical assistant to the ophthalmological section of the Royal Adelaide Hospital, Adelaide.

Dr. Howard Wadmore Linn has been appointed honorary clinical assistant to the medical section of the Royal Adelaide Hospital, Adelaide.

Diary for the Month.

Nov. 21.—New South Wales Branch, B.M.A.: Medical Politics Committee.
Nov. 22.—Victorian Branch, B.M.A.: Council Meeting.
Nov. 23.—New South Wales Branch, B.M.A.: Clinical Meeting.
Nov. 24.—Queensland Branch, B.M.A.: Council Meeting.
Nov. 28.—New South Wales Branch, B.M.A.: Ethics Committee.

Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment mentioned below without having first communicated with the Honorary Secretary of the Branch concerned, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

New South Wales Branch (Medical Secretary, 135 Macquarie Street, Sydney)—All contract practice appointments in New South Wales.

Victorian Branch (Honorary Secretary, Medical Society Hall, East Melbourne): Associated Medical Services Limited; all Institutes or Medical Dispensaries; Australian Prudential Association, Proprietary, Limited; Federal Mutual Medical Benefit Society; Mutual National Provident Club; National Provident Association; Hospital or other appointments outside Victoria.

Queensland Branch (Honorary Secretary, B.M.A. House, 225 Wickham Terrace, Brisbane, B17): Brisbane Associated Friendly Societies' Medical Institute; Bundaberg Medical Institute. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY HOSPITAL or position outside Australia are advised, in their own interests, to submit a copy of their Agreement to the Council before signing.

South Australian Branch (Honorary Secretary, 178 North Terrace, Adelaide): All Lodge appointments in South Australia; all Contract Practice appointments in South Australia.

Western Australian Branch (Honorary Secretary, 205 Saint George's Terrace, Perth): Norseman Hospital; all Contract Practice appointments in Western Australia. All government appointments with the exception of those of the Department of Public Health.

Editorial Notices.

MANUSCRIPTS forwarded to the office of this journal cannot under any circumstances be returned. Original articles forwarded for publication are understood to be offered to THE MEDICAL JOURNAL OF AUSTRALIA alone, unless the contrary be stated.

All communications should be addressed to the Editor, THE MEDICAL JOURNAL OF AUSTRALIA, The Printing House, Seamer Street, Glebe, New South Wales. (Telephones: MW 2651-2.)

Members and subscribers are requested to notify the Manager, THE MEDICAL JOURNAL OF AUSTRALIA, Seamer Street, Glebe, New South Wales, without delay, of any irregularity in the delivery of this journal. The management cannot accept any responsibility or recognize any claim arising out of non-receipt of journals unless such notification is received within one month.

SUBSCRIPTION RATES.—Medical students and others not receiving THE MEDICAL JOURNAL OF AUSTRALIA in virtue of membership of the Branches of the British Medical Association in the Commonwealth can become subscribers to the journal by applying to the Manager or through the usual agents and booksellers. Subscriptions can commence at the beginning of any quarter and are renewable on December 31. The rate is £3 *per annum* within Australia and the British Commonwealth of Nations, and £4 10s. *per annum* within America and foreign countries, payable in advance.